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EDITORIAL COMMENT

The Organization of the World Population Conference

Any expression of public interest in science through governmental action brings a risk of damaging the freedom of scientific inquiry. Yet it is obvious that governments can play an important role in the advancement of science and in the application of scientific findings to public affairs. Can science enter the forum of human affairs without losing its virtue? The problem becomes especially acute with respect to inquiries on subjects beset by conflicting interests, passions, and prejudices. It is further complicated in actions involving international relations.

The plans for the World Population Conference, to be held under the auspices of the United Nations in Rome, August 31—September 10, 1954, represent a unique experiment in cooperative inter-governmental and private action in the advancement of science, with respect both for legal principles and for scientific principles. Viewed in this light, the organization of the conference has great theoretical significance.

The idea of a world conference on population problems under the auspices of the United Nations was first advanced in a UNESCO resolution. The Population Commission of the United Nations, after due consideration, recommended that action on this proposal be postponed indefinitely. The subject was again brought to the attention of the Population Commission in a somewhat different light through a request to the Secretary-General of the United Nations by the President of the International Union for the Scientific Study of Population. The subject was referred by the Population Commission to the Economic and Social Council for its consideration. The Council directed the Secretary-General to obtain the views of member government on the desirability of holding such a conference and on appropriate procedures. After these replies had been received, the Council took definitive action.

A Resolution of the Economic and Social Council, June 10, 1952, is the "charter" of the conference. The Council had considered alternative proposals as regards responsibility for the organization of the conference. One suggested procedure was an assignment of primary responsibility to the International Union as the recognized non-governmental scientific association in this field. This suggestion was rejected in favor of a decision that the conference be held under the auspices of the United Nations, "in close collaboration with the International Union for the Scientific Study of Population and interested specialized agencies."

According to a decision of critical importance, the conference is restricted to scholars invited "in their individual capacity," rather than as representatives of governments, agencies, or organizations. Invitations are issued to experts nominated by governments (whether or not members of the United Nations), non-governmental organizations, and interested specialized agencies, and a small number of other experts with a scientific interest in population questions.

The Council authorized "the Secretary-General, in close collaboration with the International Union for the Scientific Study of Population and interested specialized agencies, to establish a small preparatory committee to be composed of their representatives and a small number of internationally recognized population experts, this committee to assist the Secretary-General in formulating an agenda . . . , and in making the necessary arrangements for the Conference." The Secretary-General has consulted this committee on all matters of principle and on many details of

conference organization. And his decisions have, in fact, been in accordance with the recommendations of this committee.

The financing of the conference is also a cooperative venture. Its operational expenses are covered by appropriations by the United Nations as the sponsoring agency and by the Government of Italy as host. The International Union has received subventions for its expenses in connection with the conference and for grants toward the expenses of participating scientists from John D. Rockefeller III, the Ford Foundation, the Population Council, and private sources in France and in Italy. Assistance is also expected from the Governments of Brazil and India, and from the International Bank, the ILO, and UNESCO. The Population Association of America has received a grant from the Carnegie Corporation toward the expenses of United States scientists taking part in the conference.

A list of twenty-six special topics was selected for consideration in meetings of the conference. Primary responsibility for planning the program in each of the twenty-six special meetings and three plenary meetings was assigned to a particular scientist as "organizer." These twenty-nine organizers include citizens of eighteen nations. They have exercised active initiative but have maintained effective coordination through correspondence with the Population Division of the United Nations and with a Sub-Committee on Organization appointed by the Preparatory Committee.

Some of the topics selected for special consideration at the conference are subjects of more general interest; others are more specialized and technical in character. Neither series is limited to questions of formal demography. Several of the meetings are focused on relations between population changes and economic development in countries in process of industrialization. Other meetings are concerned with biological and social aspects of population trends which have frequently been neglected in conventional treatments of population problems. One of these meetings is concerned with the genetic aspects of population trends.

It is expected that about 500 scientists, with broad geographical representation of the world's scientific community in this field, will participate in the conference.

The object of the conference is the exchange of ideas, the advancement of science, and the dissemination of scientific findings. It is recognized that knowledge is rarely advanced by the passage of resolutions. The Economic and Social Council prescribed that no resolutions on matters of policy be considered. The Preparatory Committee has carried this principle a step further in recommending that no attempt be made to formulate resolutions even on technical subjects. It is expected that the proceedings of the conference will be published and that they will provide an instructive document. Otherwise, the achievements of the conference will for the most part be intangible and invisible. It is, nevertheless, possible that they may be momentous in promoting a scientific approach to issues of weal and woe that are linked with changes in the magnitude, distribution, and characteristics of the world's population.

FEMALE STERILIZATION IN PUERTO RICO

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Puerto Rico is a classic example of the rapidly developing economy in which successes of public health create problems of overpopulation. With a crude death rate of 9, a birth rate of 36, and with about 650 inhabitants per square mile, the island is finding great difficulty in improving the lot of the average Puerto Rican. Yet, despite the handicaps usually present in a Catholic population, the Commonwealth has not been unprogressive in its outlook on population. A liberal law passed in 1937 permitted the dissemination of materials and information on birth control, and since that time both birth control materials and female sterilization have been available, largely free of charge, in the island's clinics and hospitals. Other papers have been concerned mainly with birth control on the island.[1] The present paper will address itself to sterilization.

The Background of Sterilization

The Commonwealth's Department of Health appears to have no explicit policy with regard to sterilization, leaving decisions on the operation to the Director of each hospital.

As near as can be determined, the practice of post-partum sterilizations was initiated in a leading private hospital about 20 years ago. A good many physicians on the island were already aware of the problems of population, the prestige of the private hospital was great, and a number of physicians came informally to learn more about operative techniques. At the same time, the efforts of Dr. José Belaval, head of the Pre-Maternal Health program (a division encompassing the birth control clinics) made many physicians interested in the pressing need for sterilization and birth control. Many physicians thought, and still think, that contraceptive methods are too difficult for lower class Puerto Ricans and regarded post-partum sterilization as the most feasible solution to the problem. Little by little its popularity grew among the medical profession, and in 1952, questionnaire returns from 453 of the island physicians indicated that 80 per cent were in favor of sterilization for reasons of health, 66 per cent in favor for reasons of poverty, and 63 per cent favored the operation when the woman had more children than she desired.[2]

If acceptance among the medical profession grew rapidly, it grew even more rapid-

[1]See J. Mayone Stycos, "Family and Fertility in Puerto Rico," *American Sociological Review*, October, 1952; "The Dynamics of Birth Control in the Lower Class of Puerto Rico," *Revista Mexicana de Sociologia*, January, 1953; and, (with Reuben Hill) "The Prospects of Birth Control in Puerto Rico," *Annals of the American Academy of Political and Social Science*, January, 1953.

[2]José Belaval, Emilio Cofresí and José Janer, "Opinión de la Clase Medica de Puerto Rico sobre el Uso de Esterilización y los Contraceptivos," mimeographed private release, 1953. Only about 50 per cent of the 900 questionnaires mailed were returned by the physicians. It is probable that objections are more current among those who did not make a return.

ly among the population which regarded sterilization as a quick and easy solution to its problems. People began flocking to public and private hospitals to have their children, if delivery could be followed by sterilization. When one metropolitan hospital temporarily abandoned sterilization as a result of criticism, it soon found its wards almost empty. Charging from 60 to 90 dollars for delivery and sterilization, private hospitals cannot keep up with the demand. Heads of public hospitals began to experience political pressures from local mayors and politicians to secure bed space for wives of loyal party members. Many public hospitals began to require two pints of blood in return for the operation, a practice which has caused no reduction in the demands. Currently, according to reports from a number of hospital obstetricians and gynecologists, demands for "la Operacion" are tremendous but are not being filled due to lack of facilities and fear of too much publicity. What data do we have on the incidence of sterilization?

The Incidence of Sterilization

No one knows precisely how many sterilizations are occurring in Puerto Rico, but a few data are available to give some idea of their frequency. In 1947, an island-wide survey of about 6000 households representative of the island was conducted by Paul Hatt. Hatt found 6.6 per cent of all ever married women sterilized, 8.3 per cent in the upper income category, 2.7 per cent in the lower income category. For marital unions started between 1930 and 1939, 11.3 per cent were sterilized.[3] At least three factors would indicate that these figures underestimate the actual incidence: (1) It is felt that Hatt's interviewing methods were not such as to elicit the most reliable responses from respondents on this delicate subject. (2) Impressionistic evidence indicates that the rate of sterilization has increased considerably since Hatt's data were collected. (3) Other studies have indicated higher rates.

In 1950, a Department of Health official requested all private and public hospitals to report the number of sterilizations performed for the year 1949. A total of 5,427 were reported, representing 17.8 per cent of the total number of hospital deliveries for that year. Since about 40 per cent of Puerto Rico's births currently occur in hospitals, it might be concluded that close to 7 per cent of all births in 1949 were reported to have been followed by sterilization. What is not known, however, is the number of women having home deliveries but hospital sterilizations. If much of this is occurring, the 7 per cent figure would be considerably higher. Furthermore, in a few cases known to the author, sterilizations are not recorded as such in the hospital records. Thus the rate may be still higher.

The rate of sterilization was found to be increasing. In the District Hospitals, where the highest incidence occurs, there was, with one exception, a steady increase in the six-year period between 1944 and 1950. Table 1 shows this in terms of index numbers, taking the sterilizations in fiscal year 1944–45 as equal to 100.

TABLE 1

TREND OF STERILIZATIONS IN DISTRICT HOSPITALS—YEARS 1944–1950 (Index Numbers)

1944–45	100
1945–46	114
1946–47	78
1947–48	120
1948–49	166
1949–50	195

One other source of data comes from a survey conducted in 1953 by Reuben Hill and the author at the Social Science Research Center of the University of Puerto Rico. During a two-month period, a random sampling was taken of men and women attending public health centers in nine parts of the island. These health centers service any individual free of charge with

[3]Paul Hatt, *"Backgrounds of Human Fertility in Puerto Rico,"* (Princeton: Princeton University Press, 1952). Computed from Table 318, p. 444.

any type of health problem. Three hundred and four males and 2,667 females who met the criteria of currently living with a partner and having had at least one birth were given a short interview concerning knowledge and practice of birth control. In terms of residence, education and fertility they do not differ greatly from the normal population. Rural residents comprise 63 per cent, median education is 4.2 years, and median number of live births in current union is 4.2. In the urban groups, however, an over proportion of young women were interviewed, median age being 29.4 as compared with 33.4 in the 1950 census. In general, however, we can say that as far as general background is concerned this group is not much different from the rest of the population. What then is the incidence of sterilization in this group? One out of every five. This almost incredible figure must of course be viewed in the light of the fact that all the cases have had some sort of contact with the health center and therefore might be more health-oriented than the rest of the population. Still, the fact that they resemble the population in many other essential characteristics indicates that the figure may not be grossly far from the truth.

Even if the figure does not represent the true incidence of sterilization, there is no reason to believe that the group is not representative of the *sterilized* population. Therefore, we can address several further questions to it: (1) What types of individuals become sterilized? (2) What is the effect of sterilization on fertility? (3) What accounts for the great popularity of sterilization?

Characteristics of the Sterilized Group

First of all, sterilization would appear to be the most popular form of birth control being practiced, accounting for slightly over half of all methods currently in use. The method is more frequently practiced by the better educated. Of all urban cases, only 12 per cent of those with no education are sterilized, whereas over 28 per cent of those with six years of education or more have used this method. In the country, the relationship is less marked, rising from 16 per cent to 24. This relation is understandable in the light of the requirements for sterilization. In private hospitals a fee is required; in public hospitals "pull" is often necessary to acquire bed space. Both these factors are associated with education, not to mention the greater interest in birth control on the part of the better educated.

An unexpected datum was that practically no difference between urban and rural groups was found with regard to sterilization. If true, this might be accounted for in terms of convenience and knowledge. The urban dweller has easier access to mechanical and chemical methods than the rural dweller. The poorly educated rural respondent, presumably with less economic resources, is at a particular disadvantage and appears to utilize sterilization even more than the urban person of the same education. Moreover, the city dweller is more informed about other methods, knowing a median number of 5.2, whereas the rural dweller knows only 4.2. It is interesting to note that Hatt's study showed the opposite tendency—sterilization was more common in the city, though residence was of much less importance than economic level. If both data were assumed to be correct, it would indicate a strong increase in rural sterilization with the past five years.

As we would expect, sterilization is also correlated with age. Those recently married would not be expected to become sterilized, and those married a very long time are of another generation. When sterilization was most needed, it was not in vogue.

TABLE 2
PER CENT STERILIZED BY LENGTH OF MARRIAGE

Less than 4 years	7.1
5–9 years	25.0
10–14 years	28.7
15–19 years	27.0
20 years or more	17.9

Now, with fertility almost completed, it loses its point. Thus the maximum point of sterilization occurs after ten years of marriage. These are women both of a modern generation and who are experiencing the maximum pinch of fertility.

The Effect of Sterilization on Fertility

Regardless of the absolute degree of sterilization occurring on the island, it is clear from all sources that the extent is considerable. Yet, as far as is known, fertility levels have not changed a great deal. Only within the past few years has the crude birth rate fallen somewhat, and this may only be due to the large number of emigrants in the fertile ages. There is some evidence for a decline in marital fertility, but it is hardly impressive. From our own data we can examine the fertility of the sterilized with the rest of the sample.

TABLE 3
PREGNANCIES IN CURRENT UNION, BY USE OF STERILIZATION

	Sterilized	Others
0–1	6.1%	15.7%
2–3	31.0	26.3
4–6	34.4	27.5
7–8	14.1	12.3
9	14.4	18.2
	100.0%	100.0%

There is not a striking difference between the two groups, showing that sterilization occurs too late to be of maximum effectiveness, well over a quarter being sterilized after the seventh pregnancy. We have noted previously the tendency for sterilization to cluster in the middle age groups. Let us now compare the effectiveness of sterilization in various age groups with the fertility of those who have used birth control.

TABLE 4
MEDIAN PREGNANCIES CURRENT UNION, BY LENGTH OF MARRIAGE AND TYPE OF BIRTH CONTROL

	Sterilization	*Other Birth Control*	*No Birth Control*
Less than 5 years	2.8	2.3	2.1
5–9	3.8	4.4	4.2
10–14	5.3	6.2	6.2
15–19	7.1	7.8	8.7
20	9.6	9.7	10.2

In each length of marriage group except the first, sterilized cases have had fewer pregnancies than those who have used birth control or who have used nothing. It can be assumed too, that by completion of childbearing, the differences between the two groups will increase, since the sterilized will have no more children, while the other groups presumably will. Notice too, how relatively ineffective other birth control methods are, the fertility in three of the five groups being practically identical with the fertility of the never users. It is clear, too, that the more recently married groups become sterilized much earlier than the longer marriage groups. To a large extent this may only reflect the fact that women in the younger age group cannot have had as many pregnancies as those in the older group, having had less time to do so; but it may also indicate a trend toward earlier sterilization. In sum while it is obvious that sterilization is an effective method of birth control, its effects on fertility tend to be vitiated by the fact that it is employed at such a late stage in the pregnancy history. We may now ask, why is this method so popular, and why is it used so late?

Attitudes Toward Sterilization

The first factor explaining the pervasiveness of sterilization is knowledge. Practically everyone knows of the "operation." In the present sample, 90.5 per cent of the women admitted knowledge of this technique, and it is felt that this figure considerably underestimates the actual knowledge.[4] Moreover, it is the method most likely to be known before marriage. The reasons for the wide knowledge of this method are at least three: (1) It has received wide publicity. (2) The nature of

[4]About 500 of the 3000 interviews were conducted by nurses rather than by trained interviewers. Analysis of their findings in contrast with those of the hired staff shows that ignorance of methods was far greater with the nurses' respondents.

the method makes it more acceptable for conversational purposes. (3) The advantages of the method for the Puerto Rican are such that its praises are loudly sung by most of those who have experienced it.

Publicity: The Catholic Church is mainly responsible for the wide publicity given to birth control in general and to sterilization in particular. By means of pulpit, pamphlet and newspaper, it has attacked birth control and sterilization over the years and thus informed many people of its existence. One writer reports, for example:

> After a mountain clinic performed a dozen or so sterilizations, it was attacked in a pastoral letter. The reading of the letter in the rural churches was followed by a wave of inquiries at public health clinics and to private doctors as to the availability of the operation which had been denounced by the bishop.[5]

A respondent indicated the dramatic fashion by which the individual priest can call attention to birth control.

> . . . we went to mass and the priest asked that everyone who practiced birth control raise their hands. He called us apart, one by one, and told us it was a very great sin to avoid children who wanted to come into this world.

The newspapers too, have been full of the controversy. In the three-year period between 1949 and 1951, close to 200 articles on birth control and the population problem appeared in the Puerto Rican press. The clergy and their spokesmen were the most frequently represented of any group, and their arguments and charges drew forth counter arguments and refutations by those in favor of birth control. Sterilization in particular has been attacked because it presents the greatest threat to the church, and because accusing the government of "mass sterilization" (esterilización en masa) is much more dramatic than accusing it of fostering birth control. Since the control by the Catholic Church over the conscience of the average Puerto Rican is slight,[6] the net effect of all this propaganda may have been to supply information to the uninformed.

Nature of the Method: Puerto Rican culture tends toward the prudish with respect to sex. Young girls are chaperoned, kept in ignorance of sexual matters, and trained to be pure and to regard the Virgin Mary as their ideal. Men expect such behavior from their wives, and therefore even between spouses there is a surprising lack of communication of sexual matters. For women, birth control is associated with the obscene and the tabooed. Consequently, this subject tends not to be discussed as freely as it is in some other cultures. Sterilization, however, has few of the overtones of the obscene. The word most commonly used is "la Operación," a completely neutral term understood to mean a process undergone in a hospital after delivery of a child to insure that no more children will be had. It is relatively easy for women to discuss this with other women and with their husbands without embarrassment, whereas the condom, douche, withdrawal, etc. cannot but be associated with the sexual organs and the sexual act. Thus in a sub-sample of 850 females, 22 percent knew of sterilization before marriage; whereas of those who knew other methods, only 1 per cent knew the diaphragm prior to marriage, only 1 per cent knew jelly, 8 per cent douche, and 12 per cent condom.

Advantages of the Method: We cannot understand the popularity of sterilization without understanding the lack of popularity of other methods of birth control. The objections to the other methods are

[5]Clarence Senior, "An Approach to Research in Overcoming Cultural Barriers to Family Limitation," *Studies in Population*, ed. S. Mair (Proceeding of the Annual Meeting of the Population Association of America), 1949, p. 150.

[6]Twenty-five per cent of the island's males and 15 per cent of its females never go to church. Another 55 per cent of each group attend only occasionally. Hatt, *op. cit.*, Table 23, p. 39. For other evidence, see articles cited in footnote 1.

many and have been described elsewhere.[7] Briefly, contraceptives are thought to be dangerous to the health, for the use of prostitutes, dirty, and productive of infidelity. Moreover, as can be deduced from Table 4, they are used erratically or inefficiently. About half the sterilized cases in our study had previously tried other methods, mainly mechanical and chemical ones. Failure brings the desire for a sure but easier method. Practically everyone cited the "sureness" of sterilization as its main advantage. This also helps to account for the fact that sterilizations are performed so late; other methods are tried first, and failures ensue before the individual turns to sterilization.[8] Probably the popularity for the method was best summed up by a lower class woman: "It is only once, sure, and then you can forget about it and don't have to use those dirty things."

The Future for Sterilization In Puerto Rico

Barring the oral pill, there seems to be little chance that any contraceptive will usurp the place of sterilization for Puerto Ricans. A drastic measure by American standards, it is a godsend to a population not sufficiently educated and motivated to practice systematic birth control. What indications do we have for its future on the island?

In considering the future of sterilization, both the attitudes of the people and of the physicians must be considered. We have already cited evidence to show that the demand for the operation far exceeds the supply and that the method is considered a panacea by many in the population. But we have also noted that those who need it most, the poorer, lesser educated, are less likely to have it than the more well to do, better educated. Not only the requirements of "price and pull" operate to the disadvantage of the lower class but certain attitudes as well. For those who object to sterilization, the principal reason is a fear of the operation. For the lower class, unfamiliar with hospitals and suspicious of doctors and operations, sterilization is feared to have deleterious effects on health. The remarks of several lower class respondents are given below:

> One isn't good anymore after sterilization. Many women have told me they cannot do hard work after it.
>
> People say that after the operation you cannot wash or do any hard work, and because of that I've never thought about being sterilized.
>
> I have seen cases of women who got sterilized and then died of T.B.
>
> Sterilization might kill her or harm her permanently. . . . I know a young lady who afterward got fat and listless.

Discounting much of the foregoing as the superstitions and rationalizations characteristic of this class with respect to all methods, there may still be truth in some of the allegations. As many as 25 per cent of Hatt's sterilized cases said they would not do it over again. Although the reasons were not given, we might suppose that a feeling of poor health consequent to the operation may have accounted for a number of the objections.[9] It is charged by some physicians that a number of their profession are performing the operation without sufficient training in its techniques. If this is true, it is a situation which demands correction, not only from the ethical point of view

[7] See footnote 1.

[8] It has been reported by Senior and others that the use of birth control involves periodic sin, whereas sterilization involves only one sin which can be confessed and forgiven. While this particular reasoning has never been uncovered in our studies of the lower class, it may be an important motivation for the more religious upper class.

[9] In the questionnaire sent to the island's physicians, eight objected to sterilization because they felt it impaired the health of the patient.

but because it may discourage many from being sterilized.

However, the principal bottleneck appears to be in supply rather than demand. Hospitals lack the facilities, and many physicians the motivation, to perform all the sterilizations that are requested. At this point it is anybody's guess as to the future provision of facilities, though there is little likelihood that they will be expanded. Should the Department of Health move from neutrality to an actively negative attitude, or should the Church improve its campaign, there is every likelihood that services will be curtailed.

Although the rate of sterilizations may be slowed, there is probably little danger of any drastic reduction. Puerto Rico is a democratic Commonwealth. Its people want sterilization and are more and more coming to recognize it as their right. Consequently, it is a good bet that they will continue to get it. If they would get it sooner, or if effetive birth control were used to space births prior to sterilization, the island would be spared a host of miseries.

MAN'S INBORN NATURE AND OUR SOCIAL PHILOSOPHY

"In spite of many nineteenth century reformers who pretend that heredity is irrelevant in human affairs, it now again seems that the opposite may be true. Man's inborn nature may well turn out to be the most important of facts in formulating a sound personal or social philosophy or in setting up political and economic organizations.

The presently known facts of human heredity already make it seem foolish in religious, moral or esthetic fields to believe that each new generation can disregard all the painfully evolved experience and wisdom of the past. Scientific psychology also must actively investigate the limitations and special characteristics of human mental life which are inborn and which do not result primarily from environmental conditioning or cultural learning.

A full scientific study of human genetics and of the importance of heredity in determining the limitations and the inborn characteristics of man's mental life is thus a great need of our age if we are to develop a sound social philosophy and maintain our democratic freedoms.

Better education, in science, social science and especially in the humanities is important in the present age of atomic development and of dangerous international tensions. A proper study of the best wisdom of the past as given in religion and in the humanities is thus now needed in a unique way. (Dr. Leonard Carmichael, Secretary, Smithsonian Institution of Washington, excerpts from Phi Beta Kappa Address, Dec. 30, 1953.)

GENETIC STUDIES OF POPULATION*

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THE PURPOSE OF THIS ARTICLE is to present a simple outline of the modifications that concepts in population genetics have undergone during the past two or three decades. Awareness of these modifications is important for those interested in eugenics but whose genetic experience is limited to the basic laws presented in the elementary textbooks; errors made by eugenists in the past can be traced in part to the limitations suggested by these basic laws. Students of human genetics may be interested in a brief statement of the current direction of experimental studies in Drosophila populations; the nature of these studies may emphasize the unique nature of the data on human inheritance and the possible importance of these data in advancing our fundamental understanding of the genetic structure of populations in general.

The two outstanding themes one finds throughout the history of population studies are the increasing awareness of the nonuniformity of the individual members of the populations and the appreciation of the genetic consequences of this heterogeneity. We will attempt to emphasize these themes by reviewing the techniques and purposes of classical genetic studies and by tracing some of the experimental investigations of natural and laboratory populations.

The science of genetics is one of the younger biological sciences; its birth can be placed at 1900, the year in which Mendel's papers were rediscovered. Mendel, through the study of different varieties of peas and their hybrids, determined the methods by which hereditary differences are transmitted from parents to offspring; the rules describing this transmission are known as Mendel's Laws.

Following the rediscovery of Mendel's results, confirmatory studies were initiated in many laboratories. For convenience these studies may be regarded as having had two main purposes: (1) The confirmation and extension of Mendel's discoveries through the analysis of many different kinds of organisms; in the United States Dr. C. B. Davenport was especially active in this field. (2) The identification of the physical particles that control hereditary patterns. These studies, known as Classical Genetics, include the identification of the chromosome as the bearer of hereditary material; the recognition that the gene, the determiner of a given trait, is a segment of the chromosome; the proof of the linear arrangement of genes on chromosomes; and the construction of maps in which the position of each gene on the chromosome is determined within very narrow limits. Outstanding in carrying out these studies was the group of investigators led by Professor T. H. Morgan at Columbia University; the material that proved invaluable in their research was the common fruit fly, *Drosophila melanogaster*. A third type of genetic analysis may also be mentioned at this point—developmental or physiological genetics. Much has been learned of normal physiological processes through the analyses of gene-controlled abnormal developmental patterns. This type of analysis includes the outstanding biochemical studies of the microbiological geneticists.

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The aspect of these studies pertinent to the present discussion is the necessity for using, in both the classical and physiological studies, easily distinguishable genetic traits. In mapping the chromosomes, for instance, it is essential that each mutant individual develop its characteristically abnormal appearance and be classified correctly; in analyzing physiological properties, too, the normal and abnormal individuals must be unmistakably identifiable. These considerations led to the use of mutant genes whose effects are not markedly affected by uncontrolled genetic variability or to the establishment, through inbreeding, of experimental material in which uncontrolled genetic variability is reduced to a minimum. Preoccupation with these sharp and easily classifiable mutants led to the mistaken assumption among nongeneticists that most—even all—gene mutations are "good" in the sense that they give clear-cut ratios of affected and nonaffected individuals in every cross. This is an erroneous impression; there are not only many traits determined by the interaction of numerous, equally important genes with small individual effects (polygenic traits) but many of the so-called "good" mutations have their expressions sharply altered by variations in modifier genes. The experimental requirements of classical genetics are basically unfavorable for studies on genetics of natural populations. In the study of populations one cannot be satisfied with the early, over-simplified concepts; an appreciation of the genetic variability is essential.

In tracing the reason for the increasing emphasis on genetic studies of variation within populations, we can consider one technique of classical genetics. It was mentioned above that these early experiments were carried out largely with "pure" lines or carefully inbred strains; the necessity for establishing these lines was in itself an acknowledgement of genetic variability. By inbreeding brothers and sisters or by self-pollinating a plant for a number of generations, one decreases the genetic variability in the line. An inbred line of this sort is extremely valuable in certain types of experiments: Different individuals from one such line have a highly uniform appearance when carrying the same mutant gene; these individuals also react similarly to specific environmental conditions. The mouse colony maintained at the Jackson Memorial Laboratory in Bar Harbor, Maine, is probably the most famous collection of inbred material; these mice are especially useful in cancer research. Different inbred lines obtained from the same original material are almost invariably different; each separate line has its own unique characteristics. This phenotypic divergence can be used as a crude measure of the genetic variation which was present but concealed in the original material.

Systematic studies aimed at the demonstration and measurement of genetic variability present in natural populations of Drosophila were initiated during the 1920's. As late as 1938, Th. Dobzhansky discussed the uniform appearance of individuals of one species (*D. pseudoobscura*) captured throughout the Death Valley region of California. Dobzhansky pointed out, however, that this apparent uniformity was no proof of genetic identity of the different individuals. The analyses used in this and later studies exposed recessive mutations that were ordinarily hidden in population beneath the cover of the dominance of their normal counterparts (alleles). Beneath this façade of normalcy of most individuals in a population lie genetic variants capable of producing the most bizarre and pathological developmental abnormalities. The frequency of these recessive mutations hidden in natural populations is indeed startling; if a lethal malformation produced by a recessive gene affects one person in every million, approximately one person in every thousand will carry the responsible gene concealed by its normal allele. If a hundred-bed hospital were sufficient for the simultaneous study of all such

affected persons within the United States, a city the size of Albany, N. Y., or Salt Lake City, Utah, would be required to house all carriers of the trait.

In sharp contrast to the relatively uniform outward appearance of the members of natural populations such as those of the Drosophila species discussed above, other species are composed of individuals with markedly different appearances. The latter species are called polymorphic. Man may serve as an excellent example of a polymorphic species. As early as 1930, Professor R. A. Fisher showed that permanent polymorphism within a population is best explained by the action of natural selection: If individuals carrying two different alleles of a gene (for instance, the carriers in the above illustration) survive better or reproduce more rapidly than individuals carrying only one or the other of the two alleles, both alleles will be retained in the population and both of the contrasting appearances caused by the different alleles will be "normal" for the population. The validity of this argument was quickly established for a number of polymorphic species. Finally—and this is very important—it has been shown that those species composed of seemingly identical individuals can be polymorphic for cryptic genetic conditions. In the California Drosophila populations mentioned before, there are at least three microscopically distinguishable forms of one particular chromosome. Flies carrying the six possible combinations of these variants (which we may call *AA, AB, AC, BB, BC,* and *CC*) are indistinguishable in outward appearance but one can easily demonstrate that those with two different variants (*AB, AC,* or *BC*) are more viable, live longer, or are more fertile than those carrying two chromosomes of the same type (*AA, BB,* or *CC*). The co-existence of these "hidden" variants within natural populations results from an active and intense selection for their co-existence and not from a passive indifference on the part of natural selection. Natural selection is continuously fitting together and trying different combinations of the hereditary endowment of these populations. The number of cases similar to this one is now so great that the absence of morphological differences upon which selection can act is no longer considered evidence that selection is inoperative.

In spite of the demonstration that natural populations carry enormous stores of genetic variation and that the existence of such variation is the result of natural selection, there persists a feeling that this demonstrable variation deals merely with genetic frills, that basically the different members of a species are identical. Now, genetics deals solely with the inheritance of differences; to postulate that important "genetic" structures are unvarying removes these structures from genetic analysis. Experimentally we are limited to the evaluation of the role observable differences play in population dynamics and to a re-examination of those situations which seemingly indicate a lack of variation.

The very same experiments that first demonstrated the existence of many concealed mutant alleles in populations seemed, paradoxically, to support the idea of an essential uniformity among the individuals of these populations. In order to appreciate this point, some understanding of the experimental procedures is required. An individual member of a cross-fertilizing species (fly or man) carries a certain number of pairs of chromosomes; one member of each pair has been received from his mother and the other from his father. If we now consider just one of these pairs, we can see that the two members need not be identical; one has been handed down from one side of the family tree while the other has been coming down the other side, so they have been separated in different individuals in the general population for a considerable time. The properties of the individual who carries these two chromosomes are ascribable to the joint action of the *pair* of chromosomes and not to either

chromosome alone. In Drosophila we possess special breeding techniques for forming individuals in which the two members of a chromosome pair are identical (homozygous individuals). By observing different individuals carrying pairs of identical chromosomes, we determine the array of effects produced by the chromosomes present in a population.

As an analogy we can consider the money possessed by five school children. The amount possessed by each child—12 cents, 23 cents, 17 cents, 9 cents, and 5 cents—is ascribable to the combination of coins possessed by each child. The relative proportions of types of coins—1 dime, 2 penies; 4 nickels, 3 pennies; 1 dime, 1 nickel, 2 pennies; 9 pennies; and 1 nickel—is a separate story. We can find out the kind of coins which the children have only by examining the 24 coins present in this small population — an examination comparable to the study of individual chromosomes. In an analysis of the chromosomes of one Drosophila population it was found that about 20 per cent of all chromosomes were lethal in homozygous individuals. An additional 30 per cent, although not killing all individuals under similar tests, reduced their chances of survival. Impressive as these figures are to those not familiar with the extent to which seemingly deleterious genes can accumulate within populations, there was still a large portion of chromosomes—roughly one-half—that seemed to have no effect on homozygous individuals. Recently it has been shown by using certain statistical refinements that within these populations of Drosophila at least 95 per cent of all chromosomes have a demonstrably deleterious effect on homozygous individuals. For practical purposes, it appears that any one chromosome carried by an individual would produce a hereditary disease or at least a constitutional weakness if it were not for the fact that most individuals in every population carry two chromosomes of a pair differing in gene content.

Contrary to the coin analogy used in the preceding paragraph, the genetic variants found within a population need not interact in a predictable manner. To illustrate this situation we must postulate that a dime in the combination 1 dime, 2 pennies is worth only 9 cents and that this combination, therefore, represents 11 cents while the same dime in the combination 1 dime, 1 nickel, 2 pennies is worth 12 cents and that this combination represents 19 cents. Two types of experiments have demonstrated this kind of gene interaction. In one experiment a number of seemingly identical chromosomes (that is, individuals carrying these different chromosomes in the homozygous condition were indistinguishable on the basis of viability or developmental rates) were allowed to recombine with one another. Chromosomal recombination is a perfectly normal process in nearly all living organisms; the two members of a pair of chromosomes exchange segments so that an individual transmits to his offspring not exact replicates of the chromosomes he received from his parents but shuffled segments of these chromosomes. Now if our experiments dealt with chromosomes that were really identical, recombination between them would yield nothing new; the recombined segments would merely reconstitute models of the original chromosomes. This is not the case; the recombined segments form chromosomes with new properties—new effects on viability and developmental rates. The original chromosomes must have been different from one another but this difference was not revealed until new chromosomal or gene combinations were formed experimentally. Apparently a dime can be worth 9 cents in some combinations and 12 cents in others.

Another demonstration of the unexpected and so far unpredictable interactions of genetic variants is based on combinations of dissimilar chromosomes. If one tests the different chromosomes carried by different individuals of a Drosophila population, one finds that these differ from one anoth-

er—some are lethal when homozygous, others are semilethal, others reduce viability somewhat, and a few, very few, have no demonstrable effects. If the special breeding technique is used to make not homozygous individuals but individuals carrying random combinations of these different chromosomes, these latter individuals are found to be very similar. In one such experiment the matings were made systematically so that each of the different chromosomes was tested in combination with two different chromosomes; chromosome *b* for instance, was tested in the combination *a/b* and in the combination *b/c*. Measurable differences between individuals carrying a chromosome in one combination and individuals carrying the same chromosome in a different combination were just as great as the differences between individuals carrying unrelated combinations. One can illustrate the apparent strangeness of these genetic experiments by repeating the same sort of a test with coins (whose values, fortunately, are additive). Compare, for instance, the differences in value of successive pairs of randomly chosen coins when every pair is included in the test and the differences in the value of successive pairs when one stipulates that each pair must contain a penny or a dime. The latter combinations are much more like one another than the unspecified combinations are.

Finally, recent experiments made by a number of workers have revealed that the genetic structure of a population is subjected not only to selection at the level of the individual but also at the level of the population itself. The effect of the latter selection is the retention in the gene pool of the population of those alleles that give on the average and in random combination with one another individuals of the highest fitness. This selection tends to integrate each population since the particular genetic variants that give rise to favorable combinations in one population need not be the same as those retained in another. This situation is made more complex by the suggestion that there is a longitudinal organization of material within each chromosome and that this organization is the result of selection acting within local populations. We know, in the case of the California fruit fly, *Drosophila pseudoobscura*, that certain combinations of microscopically recognizable chromosomes do not occur together in natural populations; among those combinations that do not exist are those that would not preserve certain gene combinations but would allow them to be disrupted by recombination. We do not yet know what types of genetic systems are established in the widespread, cosmopolitan species of Drosophila and other organisms whose movements over the face of the earth are so intimately entangled with man and his agricultural produce.

Emphasis within this short sketch has been placed on the growing recognition of the genetic complexity existing within populations. At each level of investigation there have been situations that appeared identical but which proved upon re-examination with new techniques to be dissimilar. An appreciation of the importance of genetic interaction has led to an effort to study the genetics of populations without destroying these interactions. The techniques of classical genetics, insofar as they limit themselves to the analysis of few selected genes under the highly artificial conditions of homozygosity, are no longer sufficient. The scope of the analysis has shifted to an analysis of many situations which as a whole can be regarded as characteristic of the populations under investigation.

The data available to the human geneticist give him an unique advantage in this type of population analysis. These data have been used in the past to demonstrate that Mendelian inheritance operates in our species; a demonstration that requires special techniques developed for just this purpose. This point has, indeed, been demonstrated; Mendel's Laws do operate in human inheritance. The data available can

be applied directly to the analysis of human and other Mendelian populations. Indeed, it seems as if investigators of Drosophila populations have been striving to get data for their studies like that possessed by human geneticists for human populations but, simultaneously, human geneticists have been busy devising analytical techniques that transform their population data into the sort demanded by classical genetics. The situation will be improved when the Drosophilist can turn to the human geneticist for guidance in experimental procedures.

At the outset we stated that our purpose was to trace the origin of the concepts of population genetics and to outline the modifications these concepts have undergone in recent years. The *real* purpose, however, was something quite different. If the student of human genetics has been stimulated to regard his data in a slightly different light and to re-examine the bases upon which some of his analyses are built, we will have succeeded in our real purpose. Similarly, we will have succeeded if we have persuaded the non-geneticist to examine some of the recent literature on experimental population studies and to incorporate the results of these experiments in his thinking about general population problems.

THE FLOW OF EVOLUTION

"To the geneticist the majestic flow of evolution represents the outward claim of an unceasingly stirring world. Everywhere he discovers chance: chance in the origin of mutations, chance in their consequences upon development, chance in their shuffling into innumerable combinations. Indeed, the realm of chance is awe-inspiring. Granted the origin of life on the earth, the evolution of none of its specific, present or extinct forms seems to have been of a higher necessity. Their peculiar existence, our own existence, is or was accidental. Of the endless number of possible courses which the evolution of life could have taken, the few hundred millions of species which at most originated on our planet bear witness of only an unbelievably limited accidental sample. But perhaps more awe-inspiring yet than the chance aspect of evolution is the fact of evolution itself. . . .

"The geneticist who analyzes the material and the methods of evolution in terms of molecules and of chance is not by that token a callous fellow. To reproach him with lack of religious humility is nothing but a remnant of long-worn-out pseudo-religious bigotry. One might wonder whether lack of humility is not present rather in those who try to evaluate the processes of the universe by the limited and changing standards of man's intellect, and, shocked by the inapplicability of their standards, want to deny the existence of those processes. The geneticist's probing into the elementary events that underlie evolution opns up vistas into the methods of world's being and becoming which must impress all *faculties* of the human mind." (Curt Stern, *Scientific Monthly*, October 1953.)

HEREDITY AND THE EYE*

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HEREDITARY EYE CONDITIONS RANGE from mild defects to complete blindness. Well over a hundred types of hereditary variations of the eye are listed in works on human genetics and most of these are pathologic.[1]

An analysis of the ophthalmologic records of blind children under 21 years of age in 7 states† revealed that of 2,796 cases occurring between 1926 and 1950, 1,339 were of prenatal origin. In the latter group heredity was established in 7.9 per cent and presumed in 20.6 per cent.‡ Among 20,591 adult recipients of aid to the blind in 20 states whose blindness was classified as of hereditary origin, the diagnosis was considered to be established in 0.8 per cent and presumed in 2.6 per cent, making a total of 3.4 per cent.[2] Evidence that the hereditary factor is probably greater in adults than these statistics show is suggested by the following data: (1) The percentage for some state groups in a Social Security Board study is much higher than the 3.4 per cent average. (2) An intensive study by Hamilton in Tasmania[3] revealed that 52 out of 195 blind pensioners (26.7 per cent) had a family history of similar affections of the eye. (3) Posner and Schlossman,[4] in their study of glaucoma patents, found 51 out of 373 (13.7 per cent) with demonstrable hereditary tendencies. These statistics reveal the need for more adequate records of our blind population and also suggest that hereditary diseases constitute a serious visual problem. In diagnosing hereditary diseases the physician must differentiate between prenatal abnormalities due to maldevelopment during the fetal or embryonic stages and those due to environment, e.g., syphilitic infection in the mother. According to Sorsby,[5] the clinical similarity of many congenital§ anomalies of genetic origin to those of environmental origin is suggestive of a common mechanism underlying both types. Many hereditary anomalies are overlooked for they are not suspected unless two or more relatives develop the disease or defect.

Actual blindness and eye diseases are not inherited. It is the tendency to a structural deviation from the normal that is inherited. Genetically determined anomalies may be latent and appear in a tissue that apparently developed normally and functioned normally for many years. But after an eye has developed a severe disease, it is difficult to determine whether it actually was a normal eye originally.

To understand heredity in relation to the eye, it is essential to realize that the human body is made up of millions of cells, originating from a single fertilized egg, which gives rise to the new individual. Chromosomes are the basis for hereditary phenomena. All, except the sex chromosomes, are called autosomes. These are rod-shaped bodies which are visible in the cells at the time when they are dividing and increasing in number. The chromosomes, except in the germ cells, occur in similar pairs. The male has two dissimilar sex chromosomes. One of these is the Y-chromosome, which if it fertilizes the egg will produce a male individual.

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†Illinois, Maine, Maryland, New Hampshire, Massachusetts, North Carolina and Vermont.

‡Data prepared through the courtesy of C. Edith Kerby, Associate in Statistics and Analysis of the National Society for the Prevention of Blindness from a recent but as yet unpublished study by the Society.

§Existing at or before birth.

To create a new individual, each parent contributes 24 chromosomes, making a total of 48. Along the chromosomes are distributed the genes, which are complex microscopic protein structures, also occurring in pairs. In the fertilized egg, two genes for each character are reunited. These genes act and interact in numerous ways. For example, they may be dominant, recessive or sex-linked.

A dominant gene produces its effect in the first generation and can be anticipated in succeeding generations. A recessive gene is one that does not produce its effect in the presence of the dominant gene and will not be evident physically until it is paired with an identical gene, usually resulting in abnormalities. Thus, consanguineous marriages may increase the incidence of defects due to heredity because the parents have a similar genetic make-up. Sex-linked genes produce their effects unequally in males and females. In man there are more than 20 known sex-linked characters.

To illustrate dominant and recessive inheritance, let it be assumed that two normal-appearing individuals marry, but each of them carries a recessive gene for abnormal whiteness of the skin, hair and eyes (albinism). Their genetic make-up is as follows: *Aa* and *Aa*. Because the genes arrange themselves in pairs, each pair consisting of one from the father and one from the mother, the offspring may carry the following genes: *AA*, *Aa*, *Aa*, and *aa*. All the children with the two dominant *A*'s will be normal. Those with a dominant *A* and a recessive *a* will appear normal and those with the double recessive *aa* will have very light skin, hair and eyes. Though the parents appeared normal, they transmitted albinism to their offspring. In this type of dominant inheritance, 75 per cent of the offspring appear normal and 25 per cent are abnormal.

Now let it be assumed that *Aa*, one of the children, married a normal individual *AA*. Their offspring would have the following genetic make-up: *AA* and *Aa*. There is no visible evidence of albinism in the offspring, but *AA* will have only normal progeny, while *Aa* will continue to transmit albinism because of the recessive genes.

To illustrate sex-linked inheritance, let it be assumed that a man who cannot distinguish red or green marries a woman with normal vision. Their genes can be represented by *cY* (male) and *CC* (female). By the pairing of the *cY* genes with the *CC* genes, the children will have the following genetic make-up: *Cc* and *CY*. *Y* always indicates a male. There is no gene for color blindness (*c*) in the male offspring, but the daughters carry a recessive gene for red-green blindness and a dominant gene for normal vision. This illustrates the fact that the color-blind father transmits his abnormality through his daughters, although they are unaffected.

But if two color-blind individuals marry, the following is expected: *cY* and *cc* genes are paired, resulting in the following combinations in the offspring: *cY* and *cc*. All the offspring, both male and female, are color-blind, for no dominant gene for normal vision is present.

If a color-blind man and a woman carrying a recessive gene for color blindness marry, the following is anticipated: *cY* and *Cc* will pair and the offspring will carry *Cc*, *CY*, *cY* and *cc* genes. Some of the daughters and some of the sons will be blind for red and green but not all of them.

Table I lists an assortment of eye conditions that are attributed to dominant, recessive and sex-linked inheritance. Similar or identical diseases are not always inherited according to a single genetic pattern. A number of conditions, e.g., night blindness and abnormally small eyes (microphthalmos), result from all three types of inheritance. In addition, certain diseases are caused by two or more different pairs of genes, recessive or dominant, acting together. Genes, however, may not routinely produce their effects or may not always work in the same way, or prenatal environment may be a factor. Again, it must be

TABLE 1
A Tabulation of Various Eye Conditions Associated with Dominant, Recessive and Sex-Linked Inheritance

Anatomy	*Dominant Inheritance*	*Recessive Inheritance*	*Sex-Linked Inheritance*
Eyelids and Eyelashes	Ptosis (drooping) Distichiasis (double row of eyelashes) Epicanthus (large skin folds) Lagophthalmos (difficulty in closing eyelids) Adhesions of eyelids	Distichiasis Cryptophthalmos (congenital union of eyelids)	Distichiasis
Lacrimal Apparatus (Tears and Drainage Channels)	Lack of tears		Dacryocystitis ? (inflammation of the lacrimal sac)
Eyeball	Microphthalmos (small eyes) Glaucoma (increased intraocular pressure)	Microphthalmos Anophthalmos (absence) Glaucoma Infantile glaucoma	Microphthalmos Glaucoma Juvenile glaucoma
Refractive Media of the Eye	Refractive errors Astigmatism (parallel rays of light focus on different points) Farsightedness (rays focus behind retina) Myopia (rays focus in front of retina) Anisometropia (difference in refraction of two eyes)	Astigmatism ? Farsightedness Myopia	Astigmatism ? Myopia
Muscles and Eye Movements	Strabismus (crossed eyes) Nystagmus (abnormal oscillatory movements of the eyes)	Strabismus	Paralysis of eye muscles (loss of function) Nystagmus
Sclera (Outer White Coat)	Blue discoloration Hyperemia (excess of blood) Scleromalacia (softening)		
Cornea (Transparent Anterior Part of Outer Coat of Eyeball)	Keratoconus (cone-shaped bulging) Megalocornea (large) Cornea plana (flat) Arcus juvenilis (cloudy ring in the cornea)	Keratoconus Cornea plana Kayser-Fleischer ring (green pigment ring)	Megalocornea
Lens (Transparent Spherical Body Behind Cornea)	Congenital cataract (opaqueness) Senile cataract Ectopia lentis (dislocation)	Microphakia (small)	Cataract

(Table 1 cont'd)

Anatomy	*Dominant Inheritance*	*Recessive Inheritance*	*Sex-Linked Inheritance*
Iris (Colored Circular Diaphragm) and Pupil (Opening in Iris)	Coloboma (lack of part of iris) Aniridia (absence of iris) Ectopic pupils (displaced) Pinpoint pupils (marked contraction) Eye color Albinotic iris (no pigment)	Coloboma Eye color Albinotic iris	Coloboma Albinotic iris
Choroid (Blood Vessel Coat)	Choroideremia (absence)	Gyrate atrophy (shrinking of the choroid)	Choroideremia
Retina (Nerve Coat of the Eyeball)	Retinosis pigmentosa (pigmentary degeneration) Angiomatosis (diseased vessels, hemorrhages and tumors) Retinoblastoma ? (tumors) Retinal detachment ? (separation from choroid) Night blindness	Retinosis pigmentosa Dystrophy (degeneration) Glioma (tumor) Retinal detachment ? Night blindness Color blindness	Retinosis pigmentosa Dystrophy ? Retinal detachment? Night blindness Color blindness
Optic Nerve	Optic atrophy (wasting or degeneration)	Optic atrophy	Optic atrophy

remembered that genes may assort or pair at random, mutate (change), cross over (exchange of material by similar genes), and link (not assort at random). These variations complicate the diagnosis of hereditary diseases. In man our knowledge of heredity is based mainly on records of the occurrence of abnormalities in families over several generations. Because the eye is accessible to observation and examination, geneticists have studied it extensively, and many hereditary conditions have been noted.

Eyelids and Eyelashes

The eyelids and eyelashes perform the important function of protecting the eyes from injury. Any malfunction of their movement or deformity in their shape involves a facial disfigurement and perhaps a dangerous exposure of the eyeball or an associated muscular or neural disease.

Adhesion between the upper and lower eyelids (ankyloblepharon) have been attributed to a dominant inheritance. However, in complete ankyloblepharon associated with congenital union of the eyelids (cryptophthalmos) a recessive pattern is favored.

Drooping of the eyelids (ptosis) usually results from the faulty development of the levator muscle which raises the eyelid. Ptosis has been observed as a congenital anomaly with a dominant inheritance. In certain instances the defect does not become evident until early in childhood or even later. One type that develops slowly is believed to occur as late as 40 or even 60 years of age.

Difficulty in closing the eyelids (lagophthalmos) occurs when the orbicularis muscle, which closes the eyelids, is defective as in spasm of the levator muscle of the upper eyelid or in myotonia congenita. This latter disease is characterized by spasm and rigidity of certain muscles when an attempt is made to move them after a period of rest or when mechanically stimulated. Both the

lagophthalmos and the muscular abnormality are attributed to dominant genes.

A large fold of skin on either side of the bridge of the nose may cover the inner angle of the eye. The condition is commonly seen in Mongolian idiocy, and extreme mental deficiency with skeletal defects. It may also occur independently of Mongolism. Many pedigrees have been traced over 2 or more generations, and in one family there was a possibility of sex-linkage.[5]

Conjunctiva

The conjunctiva is the membrane lining the eyelids and reflecting back on the eyeball. A few abnormalities have been attributed to hereditary factors. Slight elevations of the conjunctiva, composed of transparent connective (binding) tissue (pinguecula), have been recorded in sibships.

A hereditary factor is suspected when a triangular fold of membrane extending from the conjunctiva (pterygium) encroaches on the cornea, for it has been observed in relatives and over 2 generations, as well as in association with sex-linked night blindness and myopia.[5]

Lacrimal Apparatus

The lacrimal apparatus consists of the lacrimal gland, which secretes tears, and the lacrimal sac and drainage passages, which channel the tears into the nose. Heredity has been considered an important factor in a number of anomalies. For example, lack of tears is thought to be a dominant affection.

Congenital absence of the outlets for the tears (lacrimal puncta) and blocking (atresia) of the nasal openings have been observed in a number of sibships over several generations.

Eyeball

The size of the eye has been known to be influenced by hereditary factors. Abnormally small eyes (microphthalmos) do not seem to adhere to a uniform inheritance pattern. Dominant, recessive and sex-linked genes, respectively, appear to be involved. Environmental factors are also operative in some cases because microphthalmos has been observed in retrolental fibroplasia, a disease of premature infants involving an opaque membrane behind the lens, blindness and increased intraocular pressure (glaucoma).

In approximately 50 per cent of the cases of combined microphthalmos and anophthalmos (absence of eyeballs), mental deficiency is a complication. One pedigree revealed recessive sex-linked inheritance.[6]

Anophthalmos is due to defective embryonic development. It is thought to result from a recessive character, and consanguinity has been noted frequently.

In infantile glaucoma (increased intraocular pressure) the eyeball and cornea are large and tension is elevated. Both sexes seem to be affected equally. An autosomal recessive gene is considered responsible. In the adult type of glaucoma there is a possibility that dominant, recessive or sex-linked genes as well as autosomal genes are involved. There apparently is no evidence of a relationship between adult and infantile glaucoma. In 36 families in which infantile glaucoma was recorded, there was no diagnosis of adult glaucoma.[7]

Within the same family glaucoma tends to have the same onset and to run the same course. In one series of glaucomatous patients almost 50 per cent had similarly affected ancestors.[8]. In a pedigree,[8] consisting of 84 members and spanning 7 generations, there were 11 cases of chronic simple glaucoma. Seven of these were in women and 4 in men. Other eye anomalies were present in an additional 7 members. This is a high rate of incidence since 27 individuals in this pedigree died in youth and 14 could not be located.

Of 126 adult patients afflicted with primary glaucoma, 16 cases were possibly on a genetic basis, as there was at least one other case of the same type of glaucoma in each of the immediate families.[9] Transmission appeared to be dominant in 7 and recessive in 9. One pedigree covering 3

generations indicated a sex-linked or recessive pattern.[10]

Errors of Refraction

As light enters the eye the rays are bent. These changes in the direction of light rays are known as refraction. Light entering the eye must pass through the cornea, the aqueous fluid (just behind the cornea), the lens and the vitreous before striking the retina. The shape of the eyeball is a factor in determining whether light rays focus on the retina or focus in front of it or behind it.

If the eye is nearsighted (myopic), the rays focus in front of the retina. If the eye is hyperopic (farsighted), the rays focus behind the retina. If the eye is astigmatic (usually caused by unequal curvature of the cornea) the rays focus at a number of points on the retina. If the eyes are anisometropic (difference in refraction in the two eyes), the rays in one eye may focus in front of the retina and in the other eye behind it. In this latter condition, there are numerous refractive combinations. For example, one eye may be mildly myopic while the other is markedly myopic. Both dominant and recessive factors have been held responsible for this difference in the two eyes.

Nearsightedness and other errors of refraction may be hereditary and often are familial. For many years close work has been considered an important factor in producing myopia, but in 1941 a study of 150 unselected pairs of twin revealed heredity as the vital factor.[11] In another investigation the same incidence of myopia was found in literate and illiterate groups.[12]

The hereditary and biologic etiology of myopia has advocates. Repeated examinations of a series of myopic patients indicated that changes in refraction after the age of 7 depended on factors which affect growth.[13]

In a survey of 257 kindred with myopia, when (1) neither parent was myopic, 230 of 645 children (35 per cent) had myopia, which was purely recessive; (2) one or both parents were myopic, 309 of 628 children (49 per cent) had myopia, which was dominant.[14] The dominant type of hereditary myopia was apparently more frequent than the recessive type.

In farsightedness the mild form is considered a dominant trait while the more severe form is attributed to a recessive inheritance.

Astigmatism is generally believed to be a dominant characteristic but other modes of inheritance, e.g., recessive, intermediate and sex-linked, have been suspected.

Eye Muscles and Eye Movements

Six eye muscles are responsible for the movements of the eyes. These are the internal and external recti, the inferior and superior recti and the superior and inferior oblique muscles. Each of these muscles originates in the bony wall of the orbit (socket in which the eyeball is situated). Because they are attached to the eyeball at certain sites, each muscle governs or contributes to different movements of the eyeball.

Abnormalities of the muscles, their surrounding structures and their nerve supply result in strabismus (crossed eyes). In a series of 158 patients, there were 47 per cent who had families with 2 or more affected members.[15] This familial tendency occurred in 48 per cent of the patients with esotropia (eyes turning inward) and in 36 per cent of the patients with exotropia (eyes turning outward). The type of squint may vary a great deal in the same family. A recessive inheritance was suspected for esotropia and exotropia, with convergence (turning in of the eyes) dominant over divergence (turning out). It is thought that about 1 out of every 4 persons is a carrier of the gene for strabismus.[15]

Studies of identical twins have shown that if one has strabismus it is usually present in the other. A comparison of the incidence of primary strabismus (that unassociated with other eye defects) in identical twins and in fraternal twins[16] revealed the pres-

ence of strabismus in 81.2 per cent of both identical twins but only in 8.9 per cent of both fraternal twins. This difference may be explained on the basis that identical twins are the product of a single egg and have the same chromosomal heritage and genetic constitution. By contrast, fraternal twins are derived from different egg cells and therefore can have a different chromosomal and genetic make-up.

Sorsby[5] believes that primary strabismus occurs as a result of a dominant gene and that the expression of this gene may range from a low degree of esophoria and weakness of fusion (inability to see two ocular images of an object as one) to actual strabismus.

The term secondary strabismus refers to cases in which the muscle defect results from another eye anomaly. Such cases have been associated with hereditary farsightedness and with hereditary corneal lesions.

Total and incomplete paralysis of certain eye muscles (external ophthalmoplegia) has been attributed to a dominant or a recessive inheritance.

Abnormal eye movements include short, rapid, involuntary, rhythmic oscillations or tremors of one or both eyeballs (nystagmus). Vision is not necessarily affected. In congenital nystagmus the genetic, intrauterine or birth factor may not be revealed until 3 or 4 months after birth.[17] Nystagmus assumes especial importance because it may be associated with many hereditary ocular defects, e.g., albinism and color blindness, and with central nervous system disturbances. That the inheritance may be recessive and even sex-linked is shown by many pedigrees. Nystagmus is thought to be suppressed in approximately one-third to one-half of the women who carry the gene.[5] This would account for the theory that affected men do not pass the condition on to their sons.

Sclera

The sclera is the tough outer coat of the eye. It forms the white of the eye, and its function is protective. Several hereditary abnormalities have been noted. For example, blue discoloration of the sclera is a dominant condition, especially evident during youth. A sudden hyperemia (excess of blood) of the sclera and adjacent conjunctiva, called episcleritis fugax, and softening of the sclera (scleromalacia) associated with arthritis and kidney disease have also been attributed to dominant factors.

Cornea

The cornea is the transparent anterior part of the sclera. Alterations in the shape and size of the cornea may seriously interfere with vision because all light rays must pass through this structure before entering the eye.

In keratoconus the cornea bulges forward, assuming the shape of a cone, and the central portion becomes thin. Vision fails and there are changes in the corneal curvature, which may have a deleterious effect on the refraction of the eye. Dominant and recessive inheritance has been noted, but clinically the disease seems more prevalent in women than in men.

Congenital flatness of the cornea (cornea plana) has been attributed to dominant and recessive characteristics.

In microcornea, the cornea is small but vision may be unaffected. It has been considered sex-linked.

Megalocornea is a condition in which the cornea rapidly increases in size and appears glassy. Since it seldom affects women, a sex-linked type of inheritance is favored. However, it has been noted as a dominant characteristic.[18]

The cornea is also subject to degenerative diseases. A congenital opaqueness of the periphery of the cornea (embryotoxon) occurs in young individuals, and a cloudy ring within the corneal margin (arcus juvenilis) is occasionally observed. Dominant inheritance is suspected. Another type of ring consists of a greenish pigment at the outer edges of the cornea. This is the Kayser-Fleischer ring which is believed

to result from recessive factors.

Lens

The lens is the transparent, somewhat spherical body situated behind the cornea, serving to focus rays of light on the retina. When the lens is extremely small (microphakia), a recessive factor may be involved.

If the lens becomes opaque, it is said to be cataractous. A cataract is usually considered hereditary except when it is due to environment, e.g., infection, chemical poisoning or injury. According to many authorities, cataract is a symptom of old age but even the senile types are attributed to a dominant inheritance. There are repeated examples of congenital cataract transmitted dominantly. The time of onset from birth through middle age varies in different families and appears to be determined by dominant inheritance. Another theory is that hereditary cataract is sex-linked and tends to appear earlier in each succeeding generation.

Iris and Pupils

The iris is the circular diaphragm situated behind the cornea. The opening in its center is the pupil. Heredity may influence the size of the pupil. Marked contraction (miosis or pinpoint pupil) is considered a dominant characteristic.

In aniridia, the iris muscles are absent and there is only a narrow circle of tissue. Other congenital and hereditary anomalies may be present, such as cataract and glaucoma. A dominant inheritance has been suspected, but aniridia may be due to a chromosomal mutation (change) that behaves as a dominant character.

The color of the iris is determined genetically by several genes. The change in color with age and the sex differences in pigmentation complicate the analysis of inheritance factors. Geneticists have suggested that the first human beings all had very dark brown or black irides and that by changes in the genes through the ages variations in eye pigment evolved.[19] It is believed that pure blue eyes are recessive to darker eyes. The children of two blue-eyed parents usually have blue eyes and only rarely brown eyes. Bright blue eyes are apparently inherited as a recessive characteristic, but dominant inheritance has been noted.[20] The children of two brown-eyed parents can have irides of any lighter shade or the same brown. In albinism the iris is translucent. Pigment is not only absent in the iris, hair and eyelashes, but vision is often seriously disturbed because of lack of pigment in the retina. Transmission may be dominant, recessive or sex-linked.[21]

Choroid

The choroid is the blood vessel coat of the eye, situated between the sclera and the retina. Its function is to supply nourishment to the retina or seeing coat of the eyeball. Because of hereditary factors the choroid may be absent (choroideremia). In early life, central vision is often unaffected but these patients may be unable to see at night. In most cases, however, blindness does not occur until about 40 years of age.[22] Choroideremia is inherited in a recessive or sex-linked pattern, *i.e.*, women may have a mild form but men a severe form. Affected men have daughters carrying the gene and the whiteness of the interior of their eyes confirms the presence of such hereditary factors. In a report on the occurrence of choroideremia in three families[22] it was noted that nearly all the cases recorded were in men.

Dominant inheritance is suspected in Doyne's familial choroiditis, a hereditary degenerative inflammation of the choroid. In the back of the eye near where the optic nerve enters, there are light-colored patches in the choroid.

Retina

The retina is the innermost nerve or seeing coat of the eye. It contains cells called rods and cones. In one small area the cones are more numerous than in any other part. This is the macula lutea. In its center is

the fovea, where there are only cones. This part of the retina provides the keenest vision. The cones are particularly important for clear daylight vision and for seeing colors, while the rods are essential for twilight or night vision and in adaptation to darkness.

Congenital color blindness for red and green is a hereditary, familial sex-linked and frequently recessive anomaly, but certain pedigrees suggest a dominant factor. As a rule 50 per cent of a color-blind man's grandsons are affected. It is ordinarily transmitted through women, but its transmission on a Y-linked gene, which indicates direct transmission through the male line, has been observed.[23] It is rare for a daughter to be color-blind, for it necessitates either 2 color-blind parents or a color-blind father and a mother carrying a recessive gene for color blindness. But the case of a color-blind (deuteranomalous) 19-year-old girl has been recorded. The family history revealed that 2 brothers of her mother were deuteranomalous.[24]

Night blindness is the inability to see in a dim light. One pedigree has been traced through 10 generations, starting in 1637 and ending in 1907. There were 2,116 members in this family, and 135 were known to be night blind. Genetically, this may be a dominant or recessive defect. However, vitamin A deficiency may be a factor in some patients. When night blindness and nearsightedness exist together, recessive genes, either autosomal or sex-linked, are thought to be involved.

A general term for degenerative conditions of the retina, which are not inflammatory, is retinosis. In retinosis pigmentosa, pigment invades the retina and gradually encroaches on the optic nerve. It is frequently associated with night blindness and constriction of the fields of vision. In a pedigree covering 4 generations, in which retinosis pigmentosa and glaucoma were noted,[25] the third generation included 10 children whose father had retinosis pigmentosa and whose grandmother had the same disease. Of the 10, 4 were not examined, 2 daughters had retinosis pigmentosa and glaucoma and 3 sons had retinosis pigmentosa. In the fourth generation there were 6 normal sons and 2 normal daughters who were the offspring of the 2 sisters with combined retinosis pigmentosa and glaucoma. There are 4 or more possible inheritance patterns that have been noted in retinosis pigmentosa.

The retina may become detached or separated from the rest of the eye. Its hereditary pattern is not definitely known. Certain pedigrees suggest both dominant and recessive inheritance. Many cases of familial retinal detachment are associated with high degrees of nearsightedness. However, there are 2 pedigrees in which the disease followed a sex-linked inheritance pattern.[26]

Tumors of the retina may also be due to a certain type of inheritance.[27] The direct transmission of retinal glioma over 2 generations and one pedigree involving 3 generations have been reported.[5]

Retinoblastoma, or glioma, is a tumor arising from the retinal germ cells when the embryo is developing. Survivors of this type of glioma tend to pass the affection on to their children. Based on available pedigrees, a dominant inheritance is probable. However, because the disease is usually fatal, its existence has also been ascribed to the appearance in each generation of new genes determining its development.[28]

Dystrophies of the macular area of the retina typically show fine pigmentary changes. The inheritance has been attributed to a recessive factor, to an irregular dominant factor and to recessive sex-linkage. The dominant or irregular dominant type is rare, appearing in early childhood, but is a ravaging disease. There is a possibility of a recessive sex-linked inheritance. The recessive type is prevalent, when the disease occurs at about the ages of 10 to 14 years. Onset may be sudden and marked by a rapid decline in central vision, but certain patients retain their central vision.

The adult forms are considered to be recessive or dominant conditions beginning at about the age of 30 years.

Optic Nerve

The optic nerve connects the retina or seeing coat of the eye with the brain. A hereditary disease of the optic nerve is optic atrophy or Leber's disease. In addition to degeneration, there may also be a congenital malformation of the optic nerve. Optic atrophy may appear alone or in combination with one or more associated neural degenerations. The condition has been attributed to a sex-linked recessive character, transmitted by females and predominantly affecting males.[29] However, certain research suggests that the hereditary pattern is autosomal dominant with a changing penetration of the genes.[30] This opinion is based on a pedigree including 103 persons and covering 5 generations. Twenty-two persons (13 men and 9 women) were affected. It may even be a recessive character.

Summary and Conclusions

Genetic eye diseases range from minor defects to complete blindness. In their diagnosis prenatal and environmental factors must be eliminated. Our knowledge of human heredity is based largely on pedigrees.

Hereditary diseases of the eyelids include adhesions, drooping of the eyelids, and difficulty in opening and closing the eyelids.

In the conjunctiva, genetic factors become evident in such conditions as the formation of membranes and the appearance of elevations.

Lack of tears as well as dysfunction of the lacrimal apparatus has been found to involve hereditary characteristics.

Dominant, recessive and sex-linked genes may be responsible for abnormally small eyes and for glaucoma. The records of the familial occurrence of glaucoma present a strong case in favor of heredity as a cause in some cases.

The familial tendency to inheritance associated with nearsightedness, farsightedness and other errors of refraction has long been noted. Dominant and recessive patterns are the most frequent forms of inheritance.

Genetically, strabismus has been attributed to dominant and recessive factors. When strabismus occurs in one identical twin, the other is usually affected similarly.

In nystagmus recessive and sex-linked inheritance patterns have been noted.

The principal hereditary factor involved in certain diseases of the sclera appears to be dominant. The conditions include blueness of the sclera and inflammations.

The shape, size and transparency of the cornea have been connected with genetic factors.

In the lens the most prevalent familial disease is cataract. Its inheritance has been attributed to dominant, recessive and sex-linked genes.

The iris and pupil have been studied genetically in relation to size, absence and color. Marked contraction of the pupil is considered a dominant characteristic, as is absence of the iris. The color of the iris involves several genetic patterns. A dark color is believed to be dominant to blue eyes. In extremely light eyes, as in albinism, various modes of transmission appear to be important.

The choroid may be absent as a result of sex-linked inheritance. In degenerative conditions, dominant inheritance has been noted.

Prominent among the genetic diseases of the retina are color blindness, night blindness, retinosis pigmentosa, and tumors. The inheritance patterns vary. In the macular area, degenerative conditions have been linked with genetic factors.

The optic nerve with its intimate connection with the brain may be involved in generalized hereditary neural diseases. Blindness frequently results from atrophy or disease of the nerve. Various inheritance

patterns are involved.

In evaluating the hereditary transmission of eye diseases, an outstanding fact is that the modes of inheritance vary for individual diseases. Much of our knowledge of genetics is based on meager records, perhaps involving only one or two generations. When science can unravel the mysterious mechanisms governing the genes and their effects, great advances should be made in eliminating eye diseases, anomalies and blindness. Future research may identify numerous eye conditions with hereditary factors, the causes of which are now unknown.

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Effect of Birth Control On the Intelligence and Character of Succeeding Generations

FREDERICK OSBORN

THE INTRODUCTION OF CONTRACEPTION was accompanied in both England and the United States by greatly increased differences in average size of family between the so-called upper and the lower socio-economic groups. There was concern that if the more intelligent people had the fewest children our national intelligence would deteriorate, and various proposals were made looking toward reversing this trend. But the question was raised, "Do we know enough about human heredity, or about the distribution of hereditary factors for intelligence and character, to warrant encouraging or discouraging childbearing among particular social groups?" Today it is quite generally recognized that what we do know leads to the conclusion that any selection of births by broad social classes would leave out a great number of people of high genetic potential and include a great number of people of low potential. Eugenics must be based not on social class differences but on the differences in the quality of the different family stocks which are found scattered throughout the various socio-economic classes.

The problem is complicated by the fact that there is a social "inheritance" of the environment which in turn affects the development of intelligence; this can be traced from one generation to another and is easily mistaken for genetic inheritance. Test intelligence, which is the only kind of intelligence we know how to measure, is affected by differences in the environment as well as by differences in heredity. Hence the various interpretations which have been put on tests of the intelligence of social classes.

Social Class Differences In Test Intelligence

These differences have been the subject of much discussion and some serious study ever since the introduction of intelligence tests. Tests of drafted men in the army in World War I provided the first large-scale demonstration of these differences. Yerkes found a hierarchy of test performance[1] by occupations, with the laborer and the medical or engineering officer so far apart that there was no overlapping between the middle 50 per cent of the two groups. These and other similar findings aroused concern at the time, the tests being taken to reflect hereditary as well as environmental differences. But gross differences in intelligence test rating for groups with quite different backgrounds cannot be accepted as having significance with regard to hereditary capacities.[2] Perhaps the original interpretation of early intelligence tests is still prevalent because it reflects some of man's deepest prejudices.

Studies on the relative importance of heredity and environment refer to these two factors as they operate here and now in our population. Any drastic change in the distribution of cultural environments or any curtailment or expansion of the range of innate mental ability will alter the relative contribution of either factor.[3] In recent years the great increase in the proportion of people completing grade

[1]Yerkes, Robert, Distribution of Intelligence by Occupations, *Memoirs National Academy of Sciences*, 1921.

[2]Lorimer, Frank and Osborn, Frederick, "Dynamics of Population," The Macmillan Company, New York, 1921.

[3]Schwesinger, Gladys C., "Heredity and Environment," The Macmillan Company, New York, 1933.

school and of those attending high school has undoubtedly diminished the differences in test intelligence between the different occupational groups. But the differences are still important, and all the more so since the intelligence of children is much influenced by the environment provided by the parents. On tests[4] of large numbers of children made in Madison, Ohio City, and in New York State villages, I.Q.'s ran from an average of 115 to 116 for the children of professional people down to from 89 to 91 for the children of unskilled workers. Studies of foster children indicate that these differences can be accounted for by the known differences in the environment. Obviously a low response to intelligence tests tends to be perpetuated by a disproportionate distribution of births at the lower occupation levels, and we cannot seek the cause solely in differences in genetic capacity.

Intelligence tests measure only a few aspects of human abilities, and we have as yet no certain way of knowing how the various classes differ in other abilities or personality.

We have then a situation in which the different socio-economic classes are known to differ considerably in their average test intelligence but with little indication of the extent, if any, to which these differences may be due to variations in genetic inheritance. Among small professional groups there is some evidence of better than average genetic capacity, and for certain border-line elements at the low end of the economic scale the reverse is probably true, but for the large social groups in between these extremes the evidence is not clear.

Relation of Fertility to I.Q. of Social Groups

In considering differences in fertility between different social groups, we must remember that the inverse relation of I.Q. and fertility and its intensity are local in space and time.[5] Among English couples, married from 1851–1861, the upper and middle classes had 89 per cent as many children as the average for all classes, and agricultural laborers 105 per cent as many. At that time class differentials were relatively small. But among English couples married from 1891-1896, the upper-class-couples had only 74 per cent of the average as against 115 per cent for the agricultural laborer. The differences were beginning to be significant.[6] By 1920, differences in the use of contraceptives had still further increased. In the United States, the estimated standardized birth rate had fallen to 69 in the cities but was at 128 for the rural areas.[7]

Since that time the differentials between social groups have declined, probably as a result of the increased spread of birth control. There is evidence to which we will refer later that, as the idea and practice of family limitation becomes generally adopted throughout the population, birth differentials between social classes disappear or are even reversed. But with respect to present trends, the evidence as to the social results of class differentials in births seems quite clear. They are injurious. In each generation a major proportion of children are brought up in the homes which have been least affected by our efforts to raise educational standards and to improve the home environment, and a very much smaller proportion of children are brought up in the homes which reflect these efforts. The present distribution of births is therefore a factor directly opposed to the aim of improving the education and home environ-

[4]Lorimer, Frank and Osborn, Frederick, "Dynamics of Population," The Macmillan Company, New York, 1934, p. 159.

[5]"139th Year Book," National Society for the Study of Education: Intelligence, Its Nature and Nurture, 1940, Part I, p. 228.

[6]Lorimer, Frank and Osborn, Frederick, "Dynamics of Population," The Macmillan Company, New York, 1934, p. 79.

[7]Thompson, Warren and Whelpton, P. K., "Population Trends in the United States," 1933, p. 274.

ment of the country's children. There can be little doubt that differential acceptance of birth control contributes to a lower social inheritance, and to a lower development of intelligence. In the words of the National Resources Report of 1938, "This tendency carries social implications of such importance that they cannot safely be ignored."[8]

Looking to the future, we may expect that birth differentials *between* social groups will decline. All the present evidence indicates that these differentials are the result chiefly of the varying use of contraceptives. In the United States, at least, we may expect a continuing increase in the acceptance of family limitation and a constant increase of effectiveness in the means of controlling fertility. Our social inheritance should greatly benefit by such a change.

Relation of Fertility to I.Q. of Individuals

Differences between individuals in I.Q. and in every other measure of ability are far greater than differences between the average of the different social groups. Individuals may vary from imbecile to genius, from saint to criminal. Controlled studies of twins and of foster children indicate clearly that genetic factors run in family lines and play an important part in individual differences in developed qualities. Differences in fertility between different types of family stocks may therefore have important effects on the genetic inheritance as well as on the social inheritance of each succeeding generation.

There are no large-scale studies of differences in the fertility of various types of family stocks. The *problem* has been tackled indirectly by studies which compare the average intelligence of sibling groups with the number of brothers and sisters in each group. If the smaller sibships have the higher intelligence rating and the larger sibships the lower intelligence rating, we infer that there is an inverse relationship between intelligence and fertility.

In "Problems of a Changing Population," published by the National Resources Committee in May, 1938, a number of studies are cited on this relation between intelligence and size of family. In the words of the report,[9] "These studies show that there is a general tendency for children with inferior cultural-intellectual development to come from larger families than those with superior development, as measured by tests." This tendency for the more intelligent children to come from the smaller families appears in many studies. It was a cause of much concern following on the report of the Scottish Council for Research and Education on a large number of children.[10] One group was tested in 1932, and another fifteen years later in 1947. "The phenomenon of decreasing average score with increasing size of family is fully confirmed beyond all possible doubt." Yet the same studies suggest ". . . that at least in Scotland the average level of intelligence of school children has not fallen but may actually have risen over the past fifteen years."[11]

These apparently contradictory findings have not been fully explained. It has been suggested that the intelligence tests used in the Scottish survey are favorable to the child brought up in a small family and unfavorable to children brought up with many brothers and sisters and thus may not correctly reflect either genetic capacity for intelligence or actual developed intelligence, if applied to questions other than those used in the tests.

There are a number of small studies which indicate that when effective family limitation is universal in any particular

[8] National Resources Report, 1938.

[9] *Ibid.*, p. 148.

[10] "Royal Commission on Population Report," His Majesty's Stationery Office, London, June 1949, pp. 154–155.

[11] *Ibid.*

social group the more successful members of the group have larger families than do their less successful neighbors. The first studies to show such a trend were made by Eden and Hutchinson in Stockholm during the early 1930's[12]; other studies have been made on various groups of college graduates; and more recently in the carefully controlled Indianapolis study[13] on a group of over a thousand couples known to have practised family limitation effectively. The birth rate of all these groups was below replacement, and the studies do not deal with large enough numbers to be considered conclusive. But they all point toward a positive relation between size of family and quality of the home among parents in those groups which practice contraception effectively, and there are no studies known to the present writer which point in the opposite direction. The trend toward a more universal acceptance of birth control may, therefore, be considered highly favorable.

Since genetic differences between individuals are known to be so much greater than average genetic differences, if any, between any large social group, it seems evident that any favorable relationship between the fertility and genetic capacity of individuals would quite easily offset an unfavorable relationship between the fertility and the average genetic capacity of social groups.

The evidence as to the results of these conflicting processes has been summarized by Frank Lorimer and his tentative conclusions are as follows:[14]

> "1. There has been some low negative association between genetic capacity for intelligence and fertility during the last half century and perhaps longer, but this association has been much less than the observed correlations between intelligence test scores and the size of family.
> 2. There is an increasing genetic significance attaching to whatever correlations may be observed between intelligence test scores and fertility in urban societies today, because of the increasing equalization of opportunity.
> 3. No precise quantitative values can be assigned to these relations, and net effects may be widely different under different conditions.
> 4. These conclusions are not, at present demonstrable 'scientific facts,' but they warrant large expenditure of energy in further research on the problem.
> 5. Meanwhile, they should be taken into account as probable, or at least possible, relations in studying the expected effects of changing social conditions."

The Changing Process of Selection

Three processes seem to be operating in the world today.[15] In the first, there is no acceptance of family limitation; social group differentials are at a minimum and individual variations in family size are due more to physical than to psychological causes. Birth rates are high; death is the major factor in selection. This is the situation in the major underdeveloped areas of the world today, as it has been always everywhere in the past. In the second type of process, family limitation is accepted by part but not all of the population and the use of contraception is extremely uneven. Here class differentials are very large. Their social effects are injurious. The genetic effects are not known and may be more than offset by individual differences of fertility within each group. This is the process operating in the United States and Western Europe today.

The third process operates within small groups found only among people of West-

[12]Eden, Karl, Arvid and Hutchinson, Edward P., "Studies of Differential Fertility in Stockholm," P. S. King & Son, London, 1935.

[13]"Social and Psychological Factors Affecting Fertility," Vol. I, Whelpton, P. K. and Kiser, Clyde V., Milbank Memorial Fund, New York, 1946; Vol. II, Whelpton, P. K. and Kiser, Clyde V., editors, 1950; Vol. III, 1952.

[14]Lorimer, Frank, Trends in Capacity for Intelligence, *Eugenical News*, vol. 37, no. 2, June 1952, p. 22.

[15]Osborn, Frederick, Selective Processes in the Differential Fertility of Family Stocks, *The American Naturalist*, July 1952, p. 203.

ern European descent. Here family limitation is accepted by the entire group and the control of fertility is reasonably effective. Such studies as are available on groups of this latter kind indicate that when everyone plans their family, differentials between people of different economic levels are much reduced or even reversed. The social results should be beneficial, and because the fertility differentials in such groups appear to favor family stocks which have made the best showing in their particular environment there should be a trend toward genetic improvement from one generation to another. These findings are tentative; the studies are based on numbers too small to give valid results, but there is no evidence of a contrary effect.

Conclusions

In summary, present differences in the birth rates of different socio-economic classes are undoubtedly injurious to the social inheritance of the next generation. But the genetic effect is less well known and is less important than the genetic effect of differences in size of family of different family stocks within the various socio-economic groups. Class differentials are diminishing, and the continuing spread of birth control will further reduce or may reverse them. On the basis of genetic effects, we are not warranted in believing that one particular social group should have more or less children than another; we are warranted only in desiring wide individual variations in size of family, related to the quality of the particular family. The first step is the simple though difficult process of spreading effective means of fertility control throughout the whole population, so that parenthood may become responsible in the fullest sense of the word.

We have seen that among groups in which all couples plan the size of their families there are indications that the couples who are most successful among their neighbors, most responsible in regard to their children, most fond of children, have the largest families. It should be possible to find means to encourage these trends toward responsible parenthood. If we have the patience and the understanding for such a task, we may look forward hopefully to the future improvement of both our social and of our biological inheritance.

RECENT CHANGES IN THE FERTILITY OF CONGREGATIONAL MINISTERS

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AN INCREASING BODY OF INFORMATION on the reproductive behavior of the American people has become available in recent years, and additional important contributions are expected in the near future. Most of this material has been derived from data collected on a nation-wide scale by such government agencies as the Bureau of the Census and the National Office of Vital Statistics. Nevertheless, opportunities still exist for special surveys of highly selected, homogeneous small groups, to be undertaken by private individuals or organizations.

An investigation of this type, described as the Congregational Ministers' Eugenic Survey, was carried out during the spring and summer of 1952 by the Reverend Bedros Baharian of the Quincy Point Congregational Church, Quincy, Massachusetts, and Mrs. Betty U. Kibbee of the Population Reference Bureau, Washington, D. C. The present authors had no part in planning the survey, but the records were made available to them for statistical analysis.

The Congregational Ministers' Eugenic Survey was conducted by mail. A brief questionnaire in postcard form over the signature of Pastor Baharian was mailed to all Congregational ministers in the United States. The information requested on the questionnaire was limited to the minister's year of birth, the fact and year of marriage, the number of his children, and the year of birth of each child. The original mailing list comprised 4,024 names. About half responded to the first questionnaire. Two additional mailings brought the total response to 3,108. Of these, 45 came from women or lay persons and were discarded, leaving a total of 3,063 cards for analysis. This number represents slightly more than three-fourths of the original list—no mean accomplishment in a mail survey. The response ratio was fairly uniform throughout the country, except in the South where only three-fifths answered.

It is generally assumed that non-respondents in a fertility survey are more likely to be unmarried or childless than those who respond. To test this hypothesis, an effort was made to achieve by telephone complete coverage of a small subsample. For reasons of convenience, the Boston metropolitan area was selected for this purpose. Of the 184 ministers listed for that area, 146 had responded to the mail survey, 28 gave the required information over the telephone, 6 refused, and 4 had apparently left town. Of the 28 ministers reached by telephone all were or had been married, as compared with 94 per cent of the mail respondents in the Boston area. The average number of children per minister was the same in both groups. Because of the small numbers in the subsample, the result of the test is not conclusive as far as the entire survey is concerned, but at least it lends no support to the belief that non-response has introduced a serious bias.

Of the 3,063 ministers included in the analysis, 2,953 were or had been married at the time of the survey. Together they had produced 7,004 children. Only 27 ministers—less than one per cent—failed to report the year of birth while a somewhat larger number, 48, did not state the year of marriage. The year of birth was not given for 77 children. The "unknown" cases were distributed *pro rata*.

Because the information obtained in the survey includes the year of birth of the children, it was possible to compute measures of current[1] fertility for a series of past years. Table 1 presents total fertility rates per 100 ministers for the period 1922–49. A total fertility rate represents the number of births that would occur if the current age-specific rates would prevail throughout the reproductive life span of the parental generation, and may be computed on the basis of male or female fertility. Total fertility rates per 100 white males in the United States have been entered in Table 1 for comparison. These are based on estimated numbers of births, corrected for under-registration. All figures shown in Table 1 are 5-year sliding averages, assigned to the middle year. For example, the figures for 1922 are based on births occurring during 1920–24.

The total fertility rate per 100 ministers declined from 309 in 1922 to a low of 215 in 1937. From that point it increased steadily to 334 in 1946 and remained virtually at the same level to the end of the period of observation. The increase from 1937 to 1946 amounted to 55 per cent. The trend was similar to that for white males in the United States although the initial decline among white males was somewhat greater than among the ministers, and the recovery, somewhat smaller. As a result, the relative positions of the two series were reversed in 1940. Prior to that year the total fertility rates were slightly lower for the ministers than for the generality of white males; subsequently the rates were slightly higher among the ministers.

Total fertility rates reflect the age-specific rates for the year or group of years on which they are based. They do not necessarily present an adequate picture of the underlying pattern of fertility. Such a picture may be obtained by cohort analysis which is concerned with the actual reproductive performance of successive cohorts. Each cohort comprises the persons born (or married) in the same calendar year or group of years and is followed as close to the present time as is possible. For any cohort that can be followed to the end of its reproductive life span, the total number of children born per 100 persons can be computed. Comparison with more recent cohorts is possible in terms of the number of children born up to stated ages (or stated durations of marriage).

TABLE 1

TOTAL FERTILITY RATE PER 100 MINISTERS AND PER 100 WHITE MALES

Year•	*Ministers*	*U. S. White*
1922	309	336
1923	297	330
1924	295	320
1925	295	314
1926	282	306
1927	272	294
1928	263	286
1929	252	277
1930	250	267
1931	242	257
1932	249	250
1933	234	243
1934	231	237
1935	219	235
1936	219	237
1937	215	236
1938	226	237
1939	238	242
1940	254	252
1941	271	262
1942	287	270
1943	303	274
1944	319	285
1945	327	299
1946	334	305
1947	332	314
1948	328	323
1949	331	324

•5-year sliding averages. Rates for ministers based on 700–1,200 births.

Table 2 presents the number of children per 100 ministers, by ministers' age and year of birth. The earlier cohorts, born 1870–1904, are shown in groups of ten or five years while the later cohorts are shown

[1]Used here to designate measures of fertility based on the events (births) of a given year or group of years. Into this category fall most of the conventional measures of fertility, such as birth rates, fertility rates, and reproduction rates. Terminology on this subject is still fluid. Stolnitz and Ryder (*Population Index*, **15** (2): 114–128, April 1949) refer to "synthetic" rates. French demographers, e.g. Louis Henry ("Fécondité des Mariages," Paris, 1953), speak of rates "of the moment."

in 5-year sliding averages. The same pattern is used in all subsequent tables. Because only the years of the minister's birth and marriage, and of the birth of each child, and not the actual dates, were obtained in the survey, the "stated age" and likewise the "stated duration of marriage" in Table 5 do not refer to the exact age in completed years, but to the middle of the preceding year of life, e.g., to 29½ years, or the middle of the 30th year, instead of exactly 30 years.

The earliest cohorts shown in Table 2, *i.e.* those born in 1870–89, can be followed to age 60 which may be considered the end of the male reproductive life span. By this age, the cohort of 1870–79 had produced 324 children per 100 ministers and the 1885–89 cohort had produced 280. Later cohorts can be observed for successively shorter periods. The latest cohort, designated as "1920," comprises the ministers born in 1918-22, the youngest of whom can be followed only to the 30th year.

The earlier cohorts present a clear picture of declining fertility. The number of children ever born per 100 ministers, prior to age 45, dropped from 292 (1870–79 cohort) to 235 (1905 cohort), a reduction of 20 per cent. The cohort of 1906 appears to represent the low point of fertility. This cohort comprises the men who reached the age of marriage and family formation during the economic depression of the 1930's. This cohort has not yet reached the end of its reproductive life span. It may be expected to produce a few more offspring and to eventually reach about 240 children per 100 ministers.

Later birth cohorts show a steep rise in the number of children ever born per 100 ministers up to the age to which they can be followed. The relative increase of fertility prior to 30 years of age from the lowest cohort to the most recent cohort is 112 per cent—from 58 children per 100 ministers in the 1907 cohort to 123 children per 100 ministers in the 1920 cohort. Fertility prior to 35 years of age increased 32 per cent—from 140 children to 185 children (Chart 1).

TABLE 2

CHILDREN EVER BORN PER 100 MINISTERS, BY MINISTER'S AGE AND YEAR OF BIRTH

Minister's Year of Birth•	*Children Born Prior to Stated Age of Minister*					
	30 Years	35 Years	40 Years	45 Years	50 Years	60 Years
1870–79	*73*	*177*	*242*	*292*	*311*	*324*
1880–84	*70*	*155*	*230*	*276*	*288*	*290*
1885–89	73	169	238	268	276	280
1890–94	89	177	230	255	262	
1895–99	90	167	224	247	252	
1900–04	77	158	209	237		
1905	68	146	208	235		
1906	61	141	204			
1907	58	140	208			
1908	63	144	210			
1909	63	146	212			
1910	66	146	215			
1911	69	163				
1912	77	176				
1913	77	179				
1914	79	181				
1915	85	185				
1916	90					
1917	94					
1918	105					
1919	122					
1920	123					

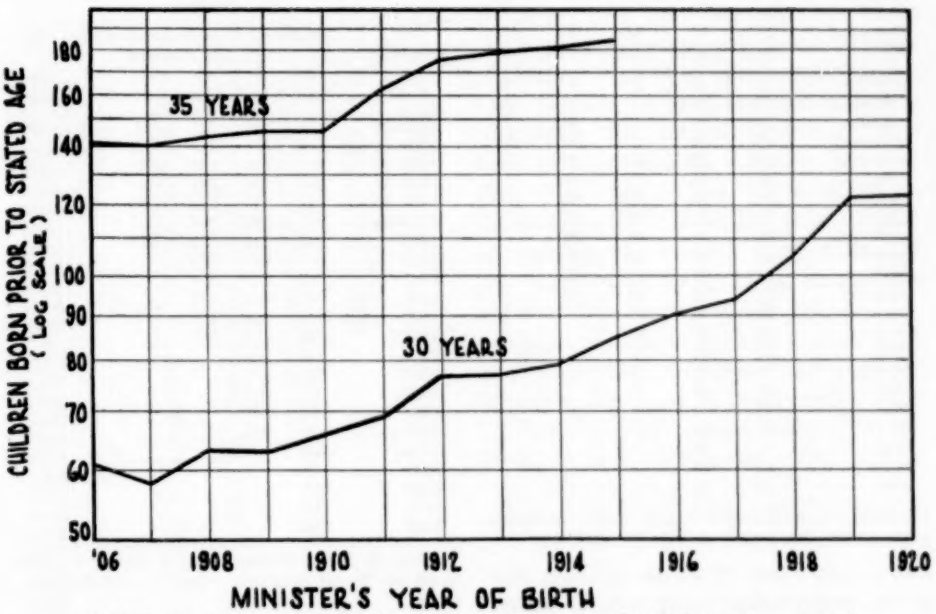
•1905–20: 5-year sliding averages. Ratio in *italics* based on 100–200 ministers, others on 250–400 ministers.

To a large extent, these increases have been the result of a trend toward earlier marriages noted among the ministers as well as in the general population. Table 3 shows that 52 per cent of the ministers born in 1920 were married before reaching age 25, and 91 per cent before age 30; while of the 1910 cohort only 27 and 73 per cent, respectively, were married by these ages; and even lower proportions among men born in the 19th century. For white males in the United States the same trend is illustrated by the following percentages ever married at age 30, obtained in successive censuses:

Year	*Per cent*
1930	73.0
1940	74.7
1950	84.4

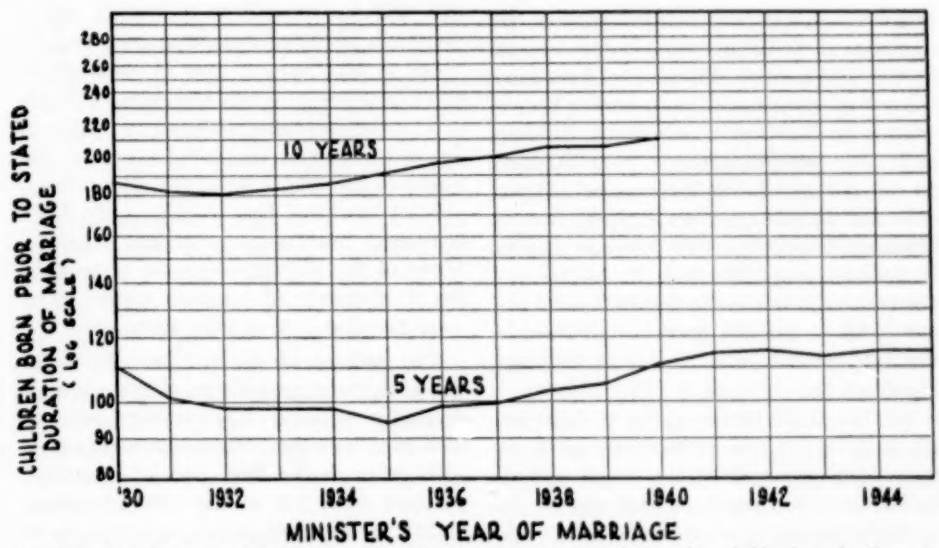
As shown in Table 3, the proportion ultimately married has been very high among the ministers throughout the period cov-

CHART 1



Children Ever Born per 100 Ministers, Prior to Stated Age, by Minister's Year of Birth

CHART 2



Children Ever Born per 100 Ministers Ever Married, Prior to Stated Duration of Marriage, by Year of Marriage

TABLE 3

MINISTERS EVER MARRIED PER 100 MINISTERS, BY AGE AND YEAR OF BIRTH

Minister's Year of Birth•	*Percent Married Prior to Stated Age* 25 Years	30 Years	35 Years	40 Years	50 Years
1870–79	*26*	*66*	*87*	*91*	*96*
1880–84	*19*	*63*	*88*	*95*	*99*
1885–89	22	64	91	96	97
1890–94	28	69	90	94	97
1895–99	29	72	88	96	97
1900–04	30	74	92	96	
1905	28	74	94	98	
1906	26	75	93	97	
1907	26	73	94	97	
1908	29	72	93	97	
1909	27	73	93	97	
1910	27	73	93	97	
1911	28	75	95		
1912	30	79	94		
1913	30	81	96		
1914	30	84	95		
1915	31	86	95		
1916	34	86			
1917	37	86			
1918	41	88			
1919	47	89			
1920	52	91			

•1905–20: 5-year sliding averages. Ratios in *italics* based on 100–200, others on 250–400 ministers.

TABLE 4

CHILDREN EVER BORN PER 100 MINISTERS EVER MARRIED, BY MINISTER'S AGE AND YEAR OF BIRTH

Minister's Year of Birth•	*Children Born Prior to Stated Age of Minister* 30 Years	35 Years	40 Years	45 Years	50 Years	60 Years
1870–79	*111*	*203*	*265*	*311*	*325*	*329*
1880–84	*111*	*175*	*241*	*282*	*291*	*292*
1885–89	*114*	186	248	275	284	284
1890–94	*128*	198	246	265	269	
1895–99	*125*	190	234	255	261	
1900–04	104	172	219	244		
1905	92	156	213	238		
1906	82	152	210			
1907	80	150	214			
1908	87	155	217			
1909	86	156	218			
1910	90	157	222			
1911	92	171				
1912	98	187				
1913	95	187				
1914	94	191				
1915	99	194				
1916	104					
1917	109					
1918	119					
1919	137					
1920	136					

•1905–20: 5-year sliding averages. Ratios in *italics* based on 75–200 ministers, others on 225–400 ministers.

ered by this study. If all the surveyed men in the more recent birth cohorts should eventually marry, which is unlikely, the record of their predecessors would be increased by an insignificant amount.

When children ever born are related to married ministers only, rather than to all ministers as in Table 2, the sharp increases in the numbers of children born to later cohorts are noticeably diminished. This is evident in Table 4 which shows children ever born per 100 ministers ever married. In contrast to relative increases of 112 per cent and 32 per cent, respectively, for all ministers, Table 4 reveals increases of only 70 per cent at age 30—from 80 children per 100 married ministers in the 1907 cohort to 136 children per 100 married ministers in the 1920 cohort—and 29 per cent at age 35—from 150 children to 194 children.

Because of the declining age at marriage, the ministers in the more recent birth cohorts have been married for longer periods by the time they reach a given age, on the average, than men in earlier cohorts. This factor accounts in part for the increases in the number of children produced by the more recent cohorts prior to each stated age. To eliminate as far as possible the influence of the shift to an earlier age at marriage, Table 5 has been prepared in terms of duration and year of marriage instead of minister's age and year of birth.

The earliest cohorts shown in Table 5, *i.e.* those married in 1900–19, can be followed to the 30th year of marriage. Duration of marriage has, in this study, been computed from the year of first marriage. Many of the children reported as born in the third decade of marriage appear to be products of second or later marriages.

The picture of the earlier cohorts, in this case, marriage cohorts, is again one of declining fertility. The number of children ever born per 100 ministers ever married, prior to the 20th year of marriage, dropped from 368 in the 1900–04 cohort to 233 in the 1930 cohort, a reduction of 37 per cent. The amount of this decline

TABLE 5

CHILDREN EVER BORN PER 100 MINISTERS EVER MARRIED, BY DURATION AND YEAR OF MARRIAGE

Year of Marriage*	Children Born Prior to Stated Duration of Marriage				
	5 Years	10 Years	15 Years	20 Years	30 Years
1900–04	*136*	*244*	*326*	*368*	*399*
1905–09	*129*	*227*	*280*	*301*	*308*
1910–14	132	241	292	313	322
1915–19	129	229	263	273	278
1920–24	125	213	248	261	
1925	116	209	237	250	
1926	117	205	232	243	
1927	114	197	226	239	
1928	113	194	223	235	
1929	115	195	225	238	
1930	110	186	218	233	
1931	101	182	220		
1932	98	181	221		
1933	98	183	226		
1934	98	185	230		
1935	94	191	237		
1936	98	197			
1937	99	200			
1938	103	205			
1939	105	205			
1940	111	209			
1941	114				
1942	115				
1943	113				
1944	114				
1945	114				

*1925–45: 5-year sliding averages. Ratios in *italics* based on 60–100, others on 200–500 ministers.

is almost twice that observed between the birth cohorts of 1870–79 and 1905, although the interval is shorter by five years. The steeper decline is the result of selection by mortality which has affected the earlier marriage cohorts. Of men who had been married at an early age at the beginning of the 20th century, a much larger proportion was still alive at the time of the survey, than of those who had entered marriage at the same time but at more advanced ages. Since persons who marry young tend to produce more children than those who marry comparatively late in life, selection by mortality increases the apparent fertility of the early marriage cohorts to a significant extent. The effect of mortality on the more recent marriage cohorts is negligible.

The low point of marital fertility is represented by the cohort of 1930, although the smallest number of children after 5 years of marriage was recorded by the cohort of 1935, and the smallest number after 10 years, by the cohort of 1932. Later marriage cohorts show increasing numbers of children per 100 ministers ever married. After 5 years of marriage, the ministers married in 1945 had produced 21 per cent more children than the marriage cohort of 1935—114 children per 100 ministers as compared with 94 children. After 10 years of marriage the relative increase was 15 per cent—from 181 children at the low point to 209 children (Chart 2).

These percentages indicate a much more modest increase in fertility than suggested by either the trend of total fertility rates (Table 1) or birth cohort analysis (Tables 2 and 4). If each marriage cohort were to retain its present gain over the low point, the cohort of 1940 would, after 20 years of marriage, reach a level of about 270 children per 100 ministers ever married, and the cohort of 1945 would produce about 280 children. Whether actual performance will fall short of these projections or exceed them is a matter of speculation.

Since the number of children born in the third decade of marriage or later will be approximately balanced by the effect of the small amount of permanent celibacy that is to be expected, a total of about 270 children per minister may be thought of as applicable to the birth cohort of 1915, roughly corresponding to the marriage cohort of 1940, and 280 children to the birth cohort of 1920. The latter figure would correspond to the actual performance of the cohort of 1885–89 (Table 2) and would exceed the expected total of the 1905 cohort, 245 children, by less than 15 per cent.

While adequate statistics are not available that would permit cohort analysis of male fertility for the population of the United States—or for the white population—it is possible to compare the Congregational ministers with a large sample of college graduates who had responded to mail

questionnaires of the Population Reference Bureau. A total of 38,123 male graduates of 1921–28 were canvassed during 1946–53, *i.e.* 25 years after the graduation of each class. Assuming an average at graduation of 23 years, these graduates may be roughly equated to the birth cohorts of 1898–1905. At an average age of 48 years, these men had produced 182 children[2] per 100 graduates. The corresponding estimate for the ministers, based on Table 2, is on the order of 240 children per 100 ministers.

It remains to be determined to what extent successive birth cohorts of ministers have produced and are producing sufficient offspring to assure their own biologic replacement. If all the ministers' children could expect to reach adult age, each 100 ministers would be adequately replaced by 100 sons. Since, on the average, about 95 girls are born along with 100 boys, 195 children of both sexes would be required. This theoretical minimum value must be increased by an appropriate allowance for mortality prior to the age of reproduction. Since the interval between two male generations is approximately 30 years, the number of children required for replacement can be conveniently estimated by multiplying the theoretical minimum (195 per 100 ministers) with 100,000 $l_{30} - l_{30}$ being the number of survivors to age 30 in a generation life table that has its origin 30 years after the birth of the parent generation. A series of generation life tables for United States white males, with origins from 1905 to 1945, were computed from official life tables from 1909–11 to 1950, supplemented by Dorn's[3] estimates for 1960 and 1970. The replacement values thus estimated are compared in Table 6 with the numbers of children actually produced by, or expected for, the corresponding birth cohorts of ministers. It is evident that throughout the period covered by this study fertility has been in excess of the level required for replacement.

In summary, then, the Congregational Ministers' Eugenic Survey has provided data on the reproductive performance of a well-defined social group. These data show a steep increase in total male fertility rates in recent years which appears confirmed by birth cohort analysis. Further study, in terms of marriage cohorts, reveals that the apparent increase in fertility has, in the main, resulted from earlier marriages than heretofore. So far as can be ascertained, the average size of family has increased only moderately. By inference the survey contributes to a better understanding of the current trend of the birth rate.

TABLE 6

CHILDREN EVER BORN PER 100 MINISTERS, FOR SELECTED BIRTH COHORTS, AND CORRESPONDING NUMBERS OF CHILDREN REQUIRED FOR REPLACEMENT

Minister's Year of Birth	*Children Born per 100 Ministers*	*Origin of Generation Life Table*	*Children Required for Replacement*
1870–79	324	1905	256
1880–89	285	1915	233
1890–99	*est* 260	1925	222
1905	*est* 245	1935	214
1915	*est* 270	1945	207

[2]Personal communication from Dr. Clarence J. Gamble. The 1.81 children per male graduate shown in the Bureau's press release of June 10, 1953, represent the unweighted mean of eight annual averages.

[3]Dorn, Harold F. Prospects of future decline in mortality rates. *Human Biology*, **24** (4) : 235–261, December, 1952. The authors wish to thank Dr. Dorn for supplying the unpublished l_x values from his work sheets.

SEX EDUCATION AND EUGENICS

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I

ONE MUST NECESSARILY adopt a long-term point of view when discussing eugenics and its application to the human race. So, in considering the utilization of a branch of education which has come to be called sex education and its possible influence in bettering the human race, it is likewise essential to consider that while such education may be of some help to the present generation of children and young people, the ultimate effects may not become evident, if at all, for decades.

Before specifically considering the possible influence of sex education on human betterment, it seems essential to define what is meant by the terms employed in the title of this discussion. The word eugenics (eu = good; gen = race or stock) was first used by Sir Francis Galton in 1883. It was defined by him as "The science which deals with all influences that improve the inborn qualities of the race; also with those that develop them to the utmost advantage." Since this basic definition provides for the utilization of various measures, especially educational means, it is pertinent to inquire into the possible use of what has been termed *sex education* in this desirable effort to advance the eugenic movement.

A leading American biologist and educator, Profesor Maurice A. Bigelow, has provided us with the basic definition of the term "sex education." According to him: "Sex education in its largest sense includes all scientific, ethical, social and religious instruction and influence which directly and indirectly may help young people prepare to solve for themselves the problems of sex that inevitably come in some form into the life of every normal human individual." It is readily evident, as stressed by Bigelow, that the term as defined includes much more than the passing on of information relating to anatomical and physiological data. While this definition of sex education has remained valid since it was first published in 1916, there has come to be general agreement that the emphasis placed on the word *sex* has militated against this aspect of education, and that another term or terms would help to advance this field of education and at the same time remove objections from various sources.

A major attempt to perform this task was made at a conference called by the U. S. Commissioner of Education held in Washington, D. C. December 7–9, 1944, and attended by Bigelow and the writer, among others. A series of principles was developed at that time, with emphasis placed on "education for personal and family living," as a substitute for the more limited term "sex education." The following are some of the statements drafted by this conference of educators:

1. Education for personal and family living is based on the thesis that the sex factor in human living, as it affects personal development, and especially in its relation to marriage, parenthood, the home, and the family, merits a dignified place among other topics of deep human interest.
2. Education for personal and family living is an integral part of the total education of each human being. It is never finished but keeps pace with increasing maturity and experience.
3. Education for personal and family

living strives for the best possible development of all physical, psychological, ethical and social aspects of life as these are in any way determined or influenced by the sex factor and its resulting traditions and associations. Thus broadly conceived it inevitably involves moral concepts and religious values.

4. Education for personal and family living is based on the recognition and acceptance of sex as basically important in human behavior and relations. A primary purpose of such education is to establish attitudes, habits and ideals toward sex which are satisfying to the individual and which, at the same time, enable him to act in a socially responsible manner.

II

It is an interesting coincidence that the same month and year that this Conference was held in Washington — December 1944 — there appeared an article in EUGENICAL NEWS entitled "Eugenics and Family Life Education." Written by Paul Popenoe, it pointed out that the study of human heredity is widely neglected in spite of its universal appeal and its practical significance to every individual. It further indicated that this is partly due to technical difficulties associated with the teaching of human heredity. Numerous textbooks on psychology, child guidance, and sociology devoted a conventional chapter or section to eugenics. In most instances, Popenoe held, the authors either knew too little about the subject or too much, and introduced complicated reactions of cytology and Mendelian mechanisms which the average student is unable to grasp. Perhaps he might have added some high school textbooks on biology as well.

Ten years ago it was still necessary to attempt to convince many educators that eugenics and family life education were essential obligations of the educational system. While some progress has been made on the college level in the interim, much still remains to be done insofar as implementation in the secondary schools is concerned.

Bigelow has pointed out that some of the chief facts of eugenics should be a part of every well-organized scheme of sex instruction and should be taught in biology courses. Probably no other topic in biology is as likely to make an ethical-social appeal, for one of the central points of eugenics is the responsibility of the individual whose uncontrolled sexual actions may transmit undesirable and heritable qualities and bring a train of disaster to generations of descendants.

In considering how this information is to be imparted, it is essential to appraise the available opportunities in school systems. In many communities a considerable segment of the high school registrants does not complete a course in biology. In other areas, the teaching is sketchy, if provided at all, and the instructors may not be adequately qualified. In one of the largest cities, for instance, the biology course is technically not a requirement, though 85 per cent to 90 per cent of the academic students — those who are taking a pre-college course —have some type of biology. In the many vocational high schools the percentage is hardly as high. Some attention is given to biology in junior high schools through the required course in general science.

In the development of courses of study in both elementary and secondary schools, there are many opportunities to incorporate information which will help to meet the specifications of the definition of sex education as written by Bigelow. But altogether too few school systems have taken advantage of the possibilities. This may be due to one or more restrictive factors, including failure to point up the material in teacher-training institutions; lack of interest of biology faculties in secondary schools in this socialized approach to the scientific material of instruction; local prejudices and ignorance of the objectives and content of such sources of instruction; and even inertia on the part of administrators and instructors. But such prejudice and

inertia may also be shared by parents who, in the last analysis, must help to provide the leadership which can bring about the introduction into the curricula of sex education or education for personal and family living.

There are other courses in the secondary schools in which this type of material can be effectively incorporated. Gruenberg, in his report on "High Schools and Sex Education," points out how the material can be integrated into the following courses: biology, general science, physiology and hygiene, physical education, home economics, social studies and English. Psychology is another area in the high school curriculum where material on sex (family life) education and eugenics is being introduced.

III

If a program covering sex (family life) education and eugenics is to be effective, it must not only be well taught by properly trained teachers but must also be aimed at reaching the largest number of students at a crucial time in their lives. This means that high school is the period during which most emphasis is to be placed on these subjects. Waiting till college courses are available is deferring a responsibility for too long a time. Still another factor involved relates to the many high school students who fail to complete their four-year courses and go on into college. It is likewise recognized that many who enter college do not remain till they graduate.

The United States Census Bureau reports indicate that in October 1951, 6,780,000 students were enrolled in our public and private high schools. Compared to this number, there were only 1,844,000 enrolled in all our colleges. Of course, many high school enrollees are in vocational high schools which do not prepare students for college entrance. These total figures indicate where the emphasis is to be placed, both from the points of view of desirability and practicality.

IV

The writer has tried to learn what high school systems in different parts of the country are teaching in the field of sex or family life education and how they relate such teaching with eugenics. Such information is somewhat difficult to gather as curricula covering these subjects have not been readily available. To meet such lapses, a further study was undertaken covering textbooks in biology and psychology being used on the high school level.

Isolation of a segment of a course of study in biology naturally cannot give a complete picture of the teaching in a high school system in sex (family life) education and eugenics. Let us take, as an example, the requirements of the New York State Education Department. The standards set for examinations in biology covering (1) behavior, (2) prevention and control of disease, (3) reproduction, and (4) heredity, seem to be fundamentally inadequate if high school students are to be provided with a guide in sex (family life) education and eugenics.

Under *behavior*, the following topics are outlined: (a) responses of plants and animals, (b) the central nervous system of man, (c) behavior patterns (nature of reflexes, conditioned reflexes, habits and voluntary acts), (d) habit formation, (e) mental and emotional adjustment, and (f) study of ductless glands.

The *prevention and control of disease section*, dealing with the usual topics of organisms, methods of disease transmission, body defenses, immunity and antitoxins, at this late date still includes *social disease* (methods of transfer and detection)! Now, what is a social disease? Presumably, this term refers to the venereal diseases, which properly belong in social hygiene education, of which sex (family life) education forms an integral part. And yet, the *health teaching syllabus* for high schools in New York State includes material on the control of venereal diseases, (so designated) with

specific reference to the study of the causes, methods of spread, and treatment of syphilis and gonorrhea.

Popenoe's criticism of the content of high school curricula in the area of *heredity* instruction was evidently well taken a decade ago, if we are to judge from the preceding. Interestingly enough, the *health teaching syllabus* for New York State, in a section given over to *Mental Health*, incorporates the following material: *heredity and environment; the physical basis of heredity; how and what traits are inherited; relative effects of heredity and environment; possibilities of improving the individual and the group, from the family unit to the Nation, through heredity and environment.*

Under the same heading of *Mental Health*, other topics listed include the *endocrine glands and their influence on behavior;* the *relation of family life to mental health; the emotions; the integrating, coordinating function of the nervous system including reflexes, instincts, conditioned reflexes, habit formation, health of the nervous system*, and a number of other topics of interest to eugenics.

The Board of Education of New York City recently completed a curriculum on general biology for the 10th-year students in academic high schools. Unit VII covering *Reproduction* is introduced "To furnish some basis for the study of heredity." The material deals with reproduction of fish, frog, bird, and mammal (rabbit or rat). The omission of human reproduction is significant, even though the curriculum is presented to the 10th-grade or junior high school students.

Unit VIII is entitled *Heredity*. It states that "the aim of this unit is to present a simple non-technical introduction to an important concept. In addition to learning how traits are inherited, the pupil is expected to gain insight into the role of the environment in modifying traits."

The following topics are covered: (1) How are we to explain why no two people look alike? (2) How has man learned the facts about heredity? (3) How is it possible for an organism to have a trait not present in either of its parents? (4) How do scientists explain the inheritance of sex? (5) What defects seem to be more frequently associated with one sex than with the other? (6) How has man improved his domesticated plants and animals? (7) How does environment influence the development of an individual's traits? (8) Why must our society continue to stress environmental factors in every generation? (9) What traits are possessed by all human beings? This unit VIII seems to cover the subject of heredity adequately, considering the age group for which the course is intended. Listed visual aids include the films "Heredity and Environment," and "Man, One Family," which was produced under the direction of Huxley and Haldane. The family life aspect, however, is not covered.

Frederick Osborn in his "Preface to Eugenics" points out: "A eugenic attitude can best be taught not by teaching eugenics as such, but by acquainting the students all along the line with materials which go into a sound eugenics. If the materials and attitudes are well integrated, the students will have eugenic attitudes as a natural part of their preparation for living." From the preceding comments on the evident lack of integration in one large school system between the curricula in two courses of study, it is plain that much remains to be done to relate selected courses in such a way that sex (family life) education and eugenics may take a distinctive pattern.

The *Ohio* Department of Education curriculum on *Health, Physical Education, Recreation* and *Safety* contains a unit on *Reproduction and Heredity*, with the following sections: (a) anatomy and physiology of reproduction; (b) sex hygiene; (c) heredity and successful marriage.

The *Oregon Health Guide Units* for teachers of Grades 10, 11 and 12 incorporate Unit XVII, covering *Mental Hygiene*, which also includes family life education.

Among the topics dealt with are the following: (a) *components of personality,* both mental and physical; (b) *factors that affect personality,* including heredity, environment, individual differences, intelligence and aptitude; (c) *development of mental health;* (d) *preparation for marriage, parenthood and family life,* including human reproduction and covering structure and functions of the male and female reproductive system; fertilization and pregnancy; birth and maternal and infant care; personal interpretation of affection and sex; love, courtship, marriage and parenthood. This is a fairly complete unit and may well serve as a guide to other parts of the country.

The curriculum for *Health Education* courses in *Virginia* outlines in some detail much material on the endocrine system, including the gonads, male and female reproductive systems. In addition, heredity and environment are included under the heading of factors influencing personality. Family relationships, preparation for adult living, and preparation for marriage are likewise given adequate consideration. It is interesting to note that all this material is incorporated in the section given over to *Mental Health.*

In *Pennsylvania,* the *Science Course of Study* includes a unit on heredity in the 7th grade, with these listed objectives: the understanding of problems of reproduction and heredity; the complexes of living genes as the source and foundation of human thought and action; and the significance and problems of adolescence. Units covering the influences exerted by the environment are provided for in the biology course for the 9th grade. Heredity, human reproduction, family life, and venereal diseases are also included in this grade course.

The preceding summaries of courses of study in several high school systems in relation to the inclusion of materials on sex (family life) education and eugenics show no uniformity of thinking on the desirability of covering these subjects.

Curricula from some other states not incorporated in the preceding discussion do not indicate as full a treatment of the subjects of concern as those mentioned. Available information is too sparse to permit the writer to draw conclusions as to whether or not most units of study covering sex (family life) education and eugenics are adequate.

V

In the attempt to obtain additional information several standard textbooks on biology for secondary schools were reviewed. The assumption was that these selected texts would be indicative of the materials covered in biology courses. Likewise, the same procedure was followed with three psychology texts. Oddly enough, it seems that the authors of the psychology books have covered materials which should be more helpful to high school students in the areas under consideration than the biology texts. This observation tends to confirm Popenoe's stricture against certain high school texts.

As previously indicated, the subjects under consideration are also incorporated under *health education* in various school systems. While the number of secondary schools having regular courses in psychology may be limited, much of the material in such courses is included under *mental hygiene* in the health education curricula.

The following notations and excerpts are of interest.

Biology Texts

1. American High School Biology
   Charlotte L. Grant, Keith Cady, Nathan A. Neal, Harper & Bros.
   Ch. 30—*How Heredity Works*
   Genetics, the Science of Heredity, How Cells Divide, Chromosomes Carry Heredity Traits, the Laws of Heredity
   Ch. 31—*Heredity in Human Beings*
   How are Physical Characteristics Inherited? Boy and Girl Babies, Some Hidden Traits, Inheritance of Mental

Traits, Choosing Future Parents, Heredity and the Human Race

2. Modern Biology

Truman J. Moon, Paul B. Mann, James H. Otto, Henry Holt & Co.
Unit 10—*Like Begets Like, The Biology of Heredity*
Ch. 54—The Basis of Heredity
Ch. 55—The Principles of Heredity
Ch. 56—Plant and Animal Breeding
Ch. 57—Genetics Applied to Human Inheritance
Ch. 58—The Changing World of Life

3. Biology in Our Lives

George W. Hunter and F. R. Hunter, American Book Co.
Problem 4—What Determines Heredity?
Problem 6—How May Our Knowledge of Genetics Be Applied to Human Beings?

4. Dynamic Biology Today

Arthur O. Baker and Lewis H. Mills, Rand McNally & Co.
Unit 9—Genetic Principles in the Improvement of Plants and Animals
Ch. 1—What Illustrations of Genetic Principles Can Be Observed in Human Beings?
Ch. 2—How Is the Reproductive Process Related to Inheritance in Plants and Animals?
Ch. 3—How Do the Laws of Heredity Operate?
Ch. 4—How Are Mendelian Principles Being Applied to the Improvement of Plants and Animals?
Ch. 5—What Personal and Social Problems Have Genetic Origins?

5. Biology in Daily Life

Frances D. Curtis and John Urban, Ginn & Co.
Unit 7—Life Continues From Age to Age
Ch. 16—Types of Reproduction
Ch. 17—Life: Past, Present and Future
What Are Some Further Important Discoveries Concerning Heredity?
How May Living Things Be Improved?

6. Basic Biology for High Schools

C. L. Fenton & P. E. Kambly, Macmillan
Unit 8—Old Characters and New Ones
Ch. 29—Heredity and Variation
Ch. 30—Order in Heredity
Ch. 31—Human Heredity
Ch. 32—Putting Heredity to Work

7. Elements of Biology

Smallwood, Really, Bailey, Dodge, Allyn and Bacon
Unit 10—Life Through the Ages
Ch. XL—Classification of Living Forms
Ch. XLI—Life in Ages Past
Ch. XLII—Progression of Life
Ch. XLIII—The Basis of Heredity

Psychology Texts

1. Psychology

T. L. Engle, World Book Co.
Ch. 6—Heredity and Environment
Ch. 7—Biological Foundations of Behavior
Ch. 12—The Growth of Friendship and Love
Ch. 17—Marriage and the Family (including sex instruction of children)

2. Psychology and Successful Living

Charles C. Josey, Scribner's
Ch. 5—Individual Differences—Causes and Consequences
How Individuals Differ
Why Individuals Differ
Importance of Heredity
Importance of Environment
Ch. 13—Adolescence
Ch. 14—Successful Marriage
Ch. 15—Child Care

3. Psychology for Living

Herbert Sorenson and Marguerite Malm, McGraw-Hill Book Co.
Sect. I—Behavior and its Foundation
Ch. 1—What You Are Born With and What You Acquire
Eugenics and Euthenics
Heredity—How It Functions
Principles of Heredity
How Environment Influences Development
How Make Most of Heredity and Environment
Sect. VI—Courtship, Marriage and Life Work
Ch. 25—Relationships With Others
Ch. 26—Success With the Opposite Sex
Ch. 27—What to Consider in Selecting a Mate
Ch. 28—Making Marriage Successful

VI

The approach in this discussion of sex (family life) education and its relation to eugenics has followed a line that seems essential at the present time. This particular field of education rests under several handicaps. At first, clergymen and physicians took the lead in attempting to guide and control the physical expression of a biological urge by frightening stories of the "wages of sin," and the suffering and horrors of the venereal diseases. The imparting of scientific facts relating to the human male and female reproductive systems fell in part to the teachers of biology, if their superiors and curricula permitted them to touch on this subject at all. These are still the so-called educational methods used in many places. But adolescents, who are most concerned, evidently did not and still do not respond to such teachings insofar as their conduct patterns are concerned. They need something more and something that is sounder pedagogically.

Along came the social biologists—men like Bigelow, Galloway, Popenoe—with a newer approach, as evidenced by Bigelow's original definition of sex education and as subsequently modified, plus the writings and teachings of others. They helped to blaze a new trail. Even then, much more was needed. The secondary school faculties in many parts of the country attempted to meet the challenge they faced. With the expansion of health and physical education courses, and thereafter those on mental hygiene, family life and psychology, new concepts began to take hold and additional teachers have participated in teaching and advising their students in the physical, emotional and social areas which were of major concern to them.

But presently difficulties began to arise as they had in previous years whenever the subject of sex came to the fore. Objections from various groups and individuals—though rarely from the students themselves—impeded the effective development of courses of study to meet the pressing need. This, however, has not been the whole story. Comparatively few teachers were prepared by study and experience to undertake the task of teaching the subjects incorporated under the term sex or family life education. Realization of this fact has been evidenced in newly developed courses on family life education in teachers' colleges, most recently at Teachers College, Columbia University.

Much opposition is still indicated by uninformed parents and others. The curriculum on *Health Education, Physical Education and Recreation* of the *West Virginia* State Department of Education states the problem in the following way:

> The sex education aspect of the human relation program will be dependent, in large, upon the attitude of the parents and community. However, the school has a major responsibility for cooperatively developing with the community—its homes, institutions, and agencies—such understandings as will insure a program which will have the support and meet the needs of the community. School administrators and teachers must make use of every available community resource in securing information, planning the content, and promoting the program. The help and guidance of physicians, nurses, clergymen, home economics and physical education teachers and others must be enlisted.
>
> Let us emphasize that in introducing sex education in the school program the first step is to gain the cooperation of parents and parent groups. It is important that parents share in the planning of what is to be taught and show a willingness to have it taught before such program is introduced. Parents can be very helpful when it is pointed out that sex education—good or bad—really begins at home long before the child starts in school. Some children come to school with the idea that sex is something not to be discussed. Others come from homes where the parents are well-adjusted and maintain those standards of good family living which help them to know that sex is incidental in the life of a well-integrated family. Of course the teacher should make use of every available resource in the effort to increase her

knowledge and her confidence in her ability to establish wholesome attitudes and understanding in boys and girls.

VII

The task of advancing the eugenics movement requires a long-term point of view. Evidently a real contribution can be made to this objective through courses in high schools and colleges covering areas of sex education or family life education and relating them to teachings on heredity, environment, and the eugenics program. Emphasis on the negative aspects, such as the concomitants of venereal disease infections and their sequelae, gives no promise of being helpful in advancing the major objectives. While it might be desirable to indicate to older students, at least, that gonorrhea may cause sterility in the male or female, and that syphilis can result in congenital syphilis or other conditions, available antibiotics are mitigating these primary infections and bringing about comparatively rapid cures.

There is a wide area of service open to those interested in eugenics. Perhaps one field that warrants immediate cultivation is broadening the base of those who should participate in the movement, if such it may be called. This seemingly is not only the task of biologists, nor even of social biologists. If we are to advance family life education, eugenics, and the technical aspects of heredity coupled with environmental factors, it may be necessary to go outside of the laboratory and the experimental animal cages; in part, at least, lay aside our computing machines, and move more effectively into the community. How all of this is to be done involves conferences with leaders of various groups and the development of a point of view which will serve as a guide to educational effort.

HEREDITY COUNSELING

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Discussions of problems in heredity counseling will be presented in each issue of EUGENICS QUARTERLY. *A list of heredity counseling centers in North America is available free upon request.*

Philosophy

THE PRIMARY FUNCTION of heredity counseling is to provide people with information regarding the genetic problems they have in their families. After some experience in counseling, it seems as if almost every family has some undesirable situation directly related to the heredity of one or more of the members. The difficulties are practical ones which the counselor can help alleviate. There is much quarreling between husband and wife as to who is "to blame" for an abnormality such as fibrosis of the pancreas. This disease may cause years of hospitalization before the death of the child, and the threat of bankruptcy is very real. The counselor cannot pay a couple's hospital bills, but he can show them that there is a one-in-four chance that each subsequent pregnancy will result in a child with cystic fibrosis and a duplication of their difficulties. It is this single question concerning the chances that the abnormality will reappear in a subsequent child which all parents want answered and which so seldom is answered correctly, even when the information is in the literature.

It is our opinion that the question concerning the chances of reappearance of an abnormality in a subsequent child is very important to the parents. They pay the physician for this information, and he should make an honest effort either to supply the answer or to admit that he does not know it. It is our impression that too many physicians fail to take either of the above alternatives and instead assure the mother that "there is only one chance in a million" of a repetition of her bad luck, or that "lightening never strikes twice in the same spot." In the families that first came to us after the lightening did strike twice, the mistaken physician was no longer considered a family friend. It has been our experience that one can explain to the parents what the chances are of another abnormal child and that they adjust to the facts very well. Being forwarned, they are psychologically forearmed if the next child does prove to have the abnormality. If the child is normal, they experience unusual gratitude and enjoy a mental uplift. In cases that have come to our attention where the parents had not been conditioned to the possibility of a second abnormal child before it appeared, the mother's mental structure was badly damaged. While we have helped to reorganize those psychological shambles, it would have been much easier to have prevented them had the mother been given nonevasive answers by her physician in the first place. It is our experience that, if the terminology is kept simple, the client can understand and profit by whatever reliable information is available. However, one needs a modicum of experience in teaching genetics if the simple facts are to be communicated to the client in an understandable way.

Who Should Do the Counseling?

Information about heredity, often incorrect, has been provided for families with

abnormal children since the development of communication by language. The advice of friends and neighbors was probably quite effective in altering the reproductive behavior of the family concerned. The most frequent ideas were fortified by taboo status or even formal incorporation into religious dogma. A good number of the states have laws regulating consanguineous marriages, which were taken directly from the Bible. Modern attitudes are greatly influenced by the collections of fact and fancy concerning human reproduction to be found in religious writings. Many of the old ideas have been taken too literally or have been distorted, so that sometimes their modern versions are less valid than the original conceptions. If advice about heredity is to be given, it would seem that the specialist in the field, the geneticist, would be in a sounder position to do so than even one's best friend. The first requirement for the counselor, then, is a reasonable knowledge of human genetics. The second requirement is that he have a feeling for the sensitivities, attitudes, and reactions of the client. An additional advantage would be a medical degree with the training it signifies. This advantage can be somewhat negated by the very strong pressure of the superior income and social prestige which the practice of medicine offers the physician in comparison with the certainty of a none too lavish salary paid by the academic institution where the counseling should be centered. Human genetics is indeed fortunate when it can keep within its embrace a physician who can resist the urge for specialized practice in favor of the still somewhat nebulous area of counseling in human genetics. The counselor will also find talents for teaching, public speaking, and popular writing to be useful.

The Client's Attitude

Our serious clients come to us before they are troubled. They show great affection for, and interest in, their abnormal child, and it gets more than its ordinary share of attention. The parents are unhappy both for the defective child and for themselves. They do not wish to repeat their misfortune; at the same time their desire to produce another, normal child is increased in most cases. They always ask what the chances are of another abnormality. We give them the figure if we have a reliable one; otherwise we tell them that we do not know the value. They usually ask us directly whether or not they should have more children. This question is the one that we do not answer because we cannot. The counselor has not experienced the emotional impact of their problem, nor is he intimately acquainted with their socioeconomic environment. We emphasize what the genetic situation is but the decision must be a personal one between the husband and wife, and theirs alone.

The decision they make can be either eugenic or dysgenic in regard to the one genetic character under consideration. If they decide to have no more children, this is a eugenic decision, that is, they will not pass on their abnormal gene either through affected children or normal "carrier" children. If, as is usually the case, the chances of producing another defective child are less than the parents feared, then they may go ahead and have more children. This latter decision would be dysgenic, that is, against the well-being of society as a whole, since it propagates the defective gene instead of letting it die out. The over-all effect of counseling is to encourage people to have more children than they had thought wise, as the chances of having bad luck are less than they had assumed (though usually vastly greater than the "one in a million" chance that may have been given them elsewhere). As time passes they become more optimistic, and the desire to "compensate" for the abnormal child usually overwhelms their fears. While it seems that the counseling is dysgenic in regard to a particular abnormal gene, it should be remembered that those people who are sufficiently con-

cerned about their future children to come to the Dight Institute for counseling have commendable concepts of their obligations as parents and these laudable characteristics should be transmitted to the next generation. In the final analysis it would be difficult to determine whether counseling has a eugenic or dysgenic result. It is clear, however, that it has a beneficial effect upon family harmony and contributes to an understanding of the biology of mankind.

Relation to Religious Precepts

Most religions have precepts which are intended to spell out the ways in which human reproduction may take place. Some of these regulations undoubtedly have very great significance; others are very difficult to understand. There is no direct connection between counseling and religious precepts. We do not answer the parents' question as to whether or not they should have more children. They must decide for themselves. Nor do we attempt to find out what decision they have in mind. We do intend to make a follow-up study in five or ten years and at that time ask them what their decision was and in what way it was affected by the information about heredity obtained at the Dight Institute.

While we are deliberately discreet in not asking the parents what their decision may be, many of them pop their decision into our laps and ask for comment on it. There is not much that we can say even then. If they actually understand the genetic situation, their decisions will also show common sense and understanding. In some cases it is clear to all there should be at least some limitation placed on the family size. Here the Roman Catholic family may find itself in a dilemma. The following situation has actually happened twice, with slight variation in detail, and is similar for other abnormalities. It illustrates clearly the serious problems which may develop.

A twenty-four-year-old intelligent Roman Catholic mother came to the Dight Institute after several years of trouble due to the fact that two of her four children had fibrosis of the pancreas. One of the defective children had died, but the other child was still living at the age of six, though half its life had been spent in hospitals. The expenses each year had been much greater than the family's total income, and they lost their first automobile, then their small house, and then their ambition. The more recent expenses have been borne by "county papers."

The county has a legal claim to any property or savings they might be able to accumulate. When the child dies, they could escape their tremendous debt to the county by moving out of the state—a solution which they consider dishonest and unacceptable. Since the client had already had two fibrotic children, she was no longer in the market for the "lightening never strikes twice in the same place" explanation. We told her that her chances were one in four of repeating at each subsequent pregnancy, which was about what she had come to expect. She had already made her decision that her two normal children and the defective children were all that they should have. After coming to this conclusion, she asked her priest for a solution to her problem. The priest agreed that the rhythm method would not be practical for a woman with her irregular menstrual cycle and already proven high fertility. The only other solution which the priest could offer was that the couple no longer live together as man and wife. She pointed out to the priest that they had a good family life and that his suggestion lacked realism in view of the twenty years of fertility which she might expect before menopause. She explained to us that contraceptives were not acceptable, as their use would involve continuous sinning. Sterilization was more acceptable to her because it involved sinning only at one time, rather than for twenty years. She considered it even a greater sin to risk having further defective children

who would suffer and die while also depriving their normal brothers and sisters of their rightful social and financial position in the community.

This woman had reached her crossroads before she came to us. She had made her choice between her two sins, the continuing one of subsequent pregnancies, with the risk of a defective child, or that of sterilization. Anyone can appreciate her dilemma, but no one can decide for her which alternative to accept.

How to Reach the Client

None of the requests for information which have come to the Dight Institute have been deliberately solicited. The publicity received has all been initiated by the publications concerned. The talks given to agencies, clubs, and societies have all been by invitation. These avenues of increasing the case load could be widened and extended greatly if the director were himself to write articles for the popular press and to initiate lectures and study groups throughout the state. This should be done, at least in theory. Practically, there is little time available for it after the case load now present is cared for.

It would seem that the most effective ways to reach the client are the more stable ones of training graduate and medical students in human genetics so that they can themselves establish heredity clinics, of becoming acquainted with the physicians who are already established, and of helping to establish heredity clinics in the large cities or medical centers where needed.

These last methods of meeting the obvious needs for genetic counseling are more conservative than publicity, and the resultant growth is slower. However, the layman will ordinarily obtain his genetic counseling at the "grass roots" level from the physician, and the latter will refer the client to the heredity clinic. In our experience such referrals bring in people with serious problems and give significant results. Many of the requests resulting from press or radio publicity are either trivial or unanswerable because they are lacking in medical data. Consequently, the steady flow and increase of case load from local physicians is to be preferred to the feasts and famines resulting from popular press reports. The great usefulness of the latter should not be underrated, however, particularly when a new clinic is being organized.

How Can the Client Reach the Clinic?

It has just been stated that the most satisfactory way for the client to reach the clinic is for him to be referred to it by his own physician. The physician may have enough background in human genetics to comprehend the problem his patient poses, but he probably would not possess the detailed research data necessary to give correct answers. Many of these research studies are published in monographs such as those of the Copenhagen heredity clinic and have no commercial distribution, or in the *Annals of Eugenics* which is so highly mathematical as to be unreadable for almost everyone. Therefore, the physician should refer his patient with a problem in genetics to a heredity clinic.

This poses an embarrassing question: Where are the heredity clinics? In the Dight Institute Bulletin for 1951 a list of ten places where genetic counseling could be obtained was given. The list was not considered complete, and since then genetic counseling has become available at Tulane University from Dr. H. W. Kloepfer and at the Children's Hospital in Boston from Dr. A. G. Steinberg. There are perhaps as many as twenty or thirty places in the United States where excellent genetic counseling may be obtained. A number of these have been overlooked by their local press and radio facilities, and in such cases the geneticist should take the initiative and develop some publicity himself. A scientist with competence in human genetics has no right to withhold his skill from a public which needs it so badly. Our experience at the

Dight Institute leaves no doubt whatever that the counseling has been of the greatest value to many of the families that have received it.

A conservative estimate would envisage at least one hundred heredity clinics distributed throughout the nation in the largest cities and medical centers, with each state having at least one. This would be less than one clinic for each million of our population, certainly not a national extravagance. It is not now clear where the money is coming from to finance this modest expansion of heredity clinics. However, if the goal is worth reaching, the funds will be found. It is not contemplated that fees will be charged for counseling. There are several practical reasons why the counseling should continue to be given free, as has been the case at all the centers.

To the orderly minded, it would seem that this public service should be financed from taxes and perhaps by the U. S. Public Health Service. Others would contend that the clinics should continue to arise at random and trust to luck for their survival. The writer would like to see a few new university clinics directly financed by the U. S. Public Health Service, if for no other reason than to compare their experience with that of the clinics now in existence. Regardless of the future sources of support, the present heredity clinics have sown the seed of a new type of social service. Heredity clinics have a future, and it will be exciting to watch it unfold.

THE BURGESS-WALLIN REPORT

A Contribution to Eugenics Through the Improvement of Marriage.[1]

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According to a most distinguished viewer-with-alarm, one of the highlights of the sex-dominated year 1953 was the immense sales of a book of statistics about the sexual behavior of less than .01 per cent of our female population. This reviewer would like to hear the comments of our scoffkinseys upon another Great Report of depraved 1953. This is based upon a mere .001 per cent of our female population together with their male partners. Like the Kinsey report it admits that its sample is overweighted, specifies precisely how, applies to itself critical internal tests, and modestly interprets its conclusions as befits scholars and gentlemen. However, it deals with the kinds of facts which are quite justly said to be more important than "mere statistics of sexual outlets."

The Burgess-Wallin evidence, supplementing but not contradicting Kinsey, also indicates a very real change in sex behavior in the last 40 years, involving women more numerously than men; and suggesting that this change is mainly in sexual stimulation, dating, petting; and intercourse among more or less engaged couples, rather than toward overall promiscuity or sexual non-possessiveness.

Professors Burgess and Wallin are the first to study engaged couples and then to follow up these same persons after their marriages. They started with 1000 couples, reached 666 of them during engagement and again from three to five years after marriage to get completed questionnaires, and in addition got interviews, similarly timed, from 124 of the couples. Seventy-two per cent of the original sample were college graduates. The book very conveniently brings in the comparable data from other studies: Burgess and Cottrell, Terman, Locke, Lang, Hamilton, Davis, Adams, Kirkpatrick, Karlsson, and others.

Prediction was a central objective of the study. As in the Burgess-Cottrell and Terman studies, data were weighted and combined in various ways until finally the correlation between a multiple prediction score and a multiple criterion of marital success was brought to the order of + .5. Success in engagement was also measured, independently of other predictive factors and of marital success; it correlated almost + .4 with marital success.

Yet as the authors themselves emphasize, prediction is not the only value of measuring marital or engagement success. First, such measurements made from time to time may indicate how a relationship is changing, and how much it is helped by counseling of this or that type and duration. Second, they enable us to spot the problem cases which most need counseling or other treatment. Third, the tests and interviews are educative to the subjects and may help them to make various decisions and adjustments without counseling. Fourth, for divers research purposes, the authors have constructed an index of marital success which seems to be applicable to widely different social classes, regions, races, and countries. They seem to think that the values measured by their index are the universal human values of primary group association, relatively independent of particular cultures (p. 506).

The reviewer, in addition, sees great importance in the study's numerous specific findings and its suggested hypotheses for further research. He would point out that fatalistic predictions of astronomical or even engineering certainty are neither pos-

[1]Burgess, Ernest W., and Wallin, Paul, *Engagement and Marriage*, Lippincott, Chicago, 1953, 819 pp., $5.50.

sible nor really desired in medicine and psychology. When we send patients with bad X-ray findings to the clinic, or engaged couples with low Burgess scores to the counselor, we are in effect saying that we should help people to upset predictions. The scientist's job is to get his predictive correlations as high as possible, but he may at the same time take comfort in the fact that he cannot get them any higher. What we most want is to know the relative probabilities of success of the different policies and treatments which are open to choice.

Among the most valuable results are negative findings which debunk popular fallacies. These may help to divert public energy from alarmism and fanatical crusades to inventive work upon specific problems. One who digests the Burgess-Wallin findings will not be impressed by those who cry out that family life is going to the dogs, nor by those who would blame its failures upon romantic overidealization, nor those others who would put the blame upon the fading ideal of virginity.

Eugenists will be interested in several findings regarding children. Only 67 per cent of these middle class, mostly college-educated, engaged persons said that they wanted children "very much." Twenty-seven per cent desired them mildly, and 6 per cent did not want children. The figures were the same for the two sexes. The somewhat reduced and selected sample questioned after marriage showed a sex difference: 64 per cent of the men and 73 per cent of the women desired children "very much." When a sample, always composed of the same 635 persons, were asked about the *number* of children they wanted, it was found that the number wanted increased after marriage among both men and women, and that this increase in the goal appeared equally in those who had and those who had not already become parents (pp. 409, 705). After marriage, 52 per cent of the men and 52 per cent of the women said they "finally wanted to have" three or more children. Even the original large engagement sample, while giving a slight majority of votes in both sexes for the two-child family, gave enough votes to three or more to overbalance by far those who wanted only one or none. During engagement the majority intended to defer their first child till after three years of marriage. Those who had during engagement expressed the wish for three or more children actually began their childbearing, on the average, sooner after marriage.

Reviewing seven other studies in addition to their own, Burgess and Wallin find in each study a definite positive correlation between marital success and the *desire* for children but absence or inconsistency of relationship between marital success and the actual having of children. A few studies show lower marital happiness scores correlated with large families, but these relationships may be due to inadequately controlled social class, income, or marriage duration variables. Other studies show that divorce is much less probable for parental than for childless couples, but that this difference declines with the duration of marriage (as declines also the absolute probability of divorce for both groups). As Burgess and Wallin show, these facts do not prove that children act as a deterrent to divorce. They may to a greater degree indicate (a) that the kind of people who do not want children are less likely to be successful in marriage, and (b) that couples dissatisfied with their marriages are more apt to postpone and hence more frequently to omit childbearing altogether.

Taken altogether these findings seem to suggest that eugenic propaganda should not stress the *duty* to have children, nor children as a calculated *means to happiness*, but rather the achievement of happy and creative marriage as an end in itself. From this, more and better raised children will be the natural outcome.

The evidence from Burgess and Wallin generally refutes Waller's theory that sexual deprivation produces romantic love as a sublimation, and that this intense state of

being "in love" produces extreme idealization, or overestimation of the virtues of the partner. The authors think that the lover's self-esteem is a more potent force than his sexual deprivation in fanning the flames of romantic love, and that this love, even though intense, is usually coupled with a more realistic judgment about the partner than much of the literature implies. People *do* love their fiancés and spouses for what they are. They rate their first, second, and third years of marriage happier in retrospect than they do that dreamy, intoxicatingly romantic year which is supposed to precede the wedding.

There is a moderate correlation of premarital intercourse with lower scores for success in engagement and in marriage. The authors agree with Terman that "the relatively small prediction weights warranted by our data on sex experience prior to marriage are in striking contrast with the importance attached by moralists to premarital chastity" (p. 371). Ninety-three per cent of the men and 91 per cent of the women who had had intercourse with the fiancé said the experience had strengthened the relationship. One per cent of the men and 5 per cent of the women said it had weakened their relationship. But as Burgess and Wallin in strict scientific fairness point out, the conventional couples, if asked, might have said unanimously that their *continence* had strengthened their relationship. When asked about the feelings and circumstances attending premarital intercourse, only a few mentioned sexual compatibility and only one cited this as a motive for having intercourse. "Whether planned or unpremeditated, intercourse occurs predominately as the culmination of couples' frequent and intensive erotic stimulation" (p. 382). Putting many things together, the authors suggest that "the experience of intercourse could conceivably give a temporary and spurious solidarity to unions which might otherwise properly succumb before rather than after marriage" (p. 372). Elsewhere the authors say, "Broken engagements, which drew strong disapproval in the past, perform a useful function in the present. . . . Further increase in broken engagements might well result in decrease in the divorce rate" (p. 302).

The correlation between the score measuring success in engagement and the actual permanence of the engagement was positive but rather low. Only the extremely high or low scores gave much indication of whether the engagement would last. But as the authors imply, engagements persist or succumb for reasons other than their inherent strength. The correlation between the engagement scores of men and the scores of their partners is only + .57. Other evidence showed that engagements and marriages are very common in which one partner is much better satisfied than the other.

The most serious gap left unfilled by this and all other studies is some statistical evidence that would guide the *matching* of partners. In all these studies the scores are earned by each partner separately. After much labor we are able to tell Helen that she stands at the 25th percentile from the top in her probability of happy marriage. Yet we cannot tell her how her rank on this scale would be affected by marrying Peter rather than John. If John stands at the 10th percentile and Peter at the 70th, and Helen has an average amount of emotional dependency, we might by a sort of mechanical common sense estimate that Helen's happiness would be greater with John than with Peter. And so would any other girl's happiness. Our actual common sense goes further, for it tells us that the result depends more upon *what kinds* of persons John, Peter, and Helen are than upon what their scores are. It is true that Burgess and Wallin's predictive items include facts about the engagement and other *joint* behavior of the couple, and a few simple "combinations of personality" discovered by a rather mechanical empiricism. But what we sorely need in this field is

hypotheses such as the theory of complementary needs developed by Winch, Gray and the Ktsanes[2] and a research design sharpened up to test these hypotheses. We do know that similarity of religion, cultural and social backgrounds, of intelligence and education, etc., tend to favor success in marriage, but we have reason to believe that homogamy in temperament and personality characteristics is not advantageous. The favorable condition is not describable as the "matching of opposites" (which may be a meaningless phrase), but more probably as matching of complementary needs.

Burgess and Wallin devote a chapter to "Forecasting Marital Success." This is distinguished from "prediction" in that the observers make overall estimates after studying case records and other available information about the subjects, instead of mechanically adding up a lot of scores. The authors obtain rating scale "forecasting scores" correlating about + .4 with marriage adjustment. Although they did attain one prediction score correlation of about + .5, the general run of the correlations fails to convince the reader of the authors' general conclusion that statistical (*i.e.*, mechanically statistical) prediction is superior to case study forecasting (p. 588).

The authors find that sexual adjustment in marriage is correlated about + .5 with general marital happiness but varies according to a peculiar pattern. "Marital failure is much more likely to be reflected in the sexual adjustment of men, whereas marital success is more likely to be reflected in the sexual adjustment of women" (p. 696). Traditionally, and still actually on the average, women in our society, more than men, identify sex with marriage and look upon sex as an expression of affection not to be enjoyed apart from it. Consistently with this, they expect less from the sexual relationship per se and are more tolerant of its shortcomings. Yet the modern marriage credo stresses equality of sexual satisfaction and makes the husband feel guilty if he fails to induce orgasm in his wife. This may lead to experimental remedies which sometimes do more harm than the disease. According to Burgess and Wallin, the presumption is that these difficulties of sexual satisfaction in marriage are not biological, but psychogenic, cultural, and social in origin, and therefore susceptible to treatment (p. 697). On the other hand, Kinsey sees the basic sex difference as the much greater capacity of the male to respond to psychosexual (conditioned) stimuli, a difference extending beyond our culture and evene beyond the human species. Kinsey too thinks the resulting difficulties can be remedied, depending upon "our willingness to accept the realities which the available data seem to indicate."[3] If Kinsey's diagnosis is correct, it would seem to suggest that we should cease blanket condemnation of the "double standard," and rather try to devise a double standard that would not be unfair like the traditional one.

Perhaps the most promising correlation discussed by Burgess and Wallin is that between marital satisfaction and the adaptability of personality imputed to the spouse. Such a correlation of + .64 to + .67 was found by Karlsson (p. 639). Burgess and Wallin then analyze adaptability and find that it includes empathy and "command of appropriate responses." The latter looks suspiciously like the kind of thing taught by finishing schools and by teachers of the arts, speech, and drama. It might be that our Freud-reinforced ideals of sincerity, self-acceptance and naturalness have misled us into neglecting the old-fashioned cultivation of manners and other behavioral skills. It might still be true that in many situations the shortest way out of anger into love is to begin *acting* lovingly no matter how one feels.

[2]See Winch, Robert F., *The Modern Family*, Holt, p. 404, and Ktsanes, Thomas and Virginia in Winch and McGinnis, eds., *Selected Studies in Marriage and the Family*, Holt, 1953, p. 435.

[3]See Kinsey, Alfred, *et al.*, *Sexual Behaviour in the Human Female*, Saunders, 1953, pp. 649, 689.

BOOK REVIEWS

World Population and Production — Trends and Outlook: W. S. and E. S. Woytinsky, The Twentieth Century Fund, New York, 1953, lxxii, 1268 pp., $12.00.

This book is certain to be one of the most widely quoted references of the next generation. Here is a work which runs to over 1200 double-column pages, contains some 850 ambitious tables, maps and graphs, and with equal facility ranges over the following: world population movements since antiquity, urbanization, health needs and outlook, consumption and income, natural resources, types of economic systems and a detailed account of each of the major industries and products in agriculture, energy and mining, and manufactures. Nor is this all. A second volume to be issued soon will deal with world trade and investment, transportation, public finance and political organization. The mere mortal can only marvel at the unique blend of scope and detail achieved in this project.

A far longer summary of contents would fail to do justice to the factual sweep of these pages. The Woytinskys have striven for a rare combination of empirical perspectives: historical and current, international and regional, short and long-run. In so doing they have managed the vast materials at their disposal with both tact and circumspection. Though the level of documentation they have elected to present is nothing less than massive, the exposition is consistently effortless and restricted to emphasis on major patterns. The comments on the limitations of published data are excellent; one often wishes the authors had paid more attention to their own reservations, but the major slips arising on this score seemed to the reviewer relatively small, comparing favorably with far more specialized surveys. There are, of course, problems of selection and emphasis. For example, the striking postwar declines in mortality in many underdeveloped areas are surely more significant than Western occupational differences in mortality before 1935; yet it is the latter phenomenon which is documented, while the former receives only scattered mention.

There can be no question, however, but that this is a first-rank achievement in empirical synthesis. The reviewer would recommend the book as an exceptionally useful reference in any of the fields it covers; in some areas it may well be the best first source now available.

Opinions are likely to be more variable about its value in other directions. The quality of the authors' descriptive efforts seemed to the reviewer in marked contrast to the status of their major interpretations and prognoses. Space permits consideration of only a few issues.

The Woytinskys believe that "The growth of world population in the past three hundred years . . . has been a unique, unprecedented and unrepeatable phenomenon of limited duration." Long-run predictions are recognized to be notoriously fallible but "The important point is that the period of rapid growth is approaching its end and that world population will be stabilized, probably at a level substantially above the anticipated figure for the turn of the century (3,250 million). The limit may be 4 billion . . . or somewhat more," to be reached after the twenty-first century. These anticipations probably explain in good part the authors' view on "the population problem." A theme which recurs throughout the book is that "The technological progress initiated in the modern industrial nations and now spreading to the remotest corners of the world is the answer to questions on the carrying capacity of the planet, the depletion of its natural resources and the pressure of overpopulation." Again, ". . . overpopulation is no more responsible for poverty in a large part of the world than technological progress is to blame for mass unemployment during a depression."

Now it might be argued with some reason that one man's guess on such global matters is often as good as another's. What is difficult to see in the present connection

is where any of the authors' enormous scholarship has been brought to bear in arriving at these conclusions. Their several hundred pages on demographic trends provide no detectable basis for deciding whether past population growth can or can not be repeated (it will, of course, prove to be "unique"). The populations of many of today's underdeveloped nations are increasing at rates which are explosive by historical standards. Birth rates have fallen little if at all in the non-industrial world, and there is ample evidence that death rates can be lowered very rapidly. If the economic progress the authors envisage for most underdeveloped areas were to come to even limited fruition, the strong likelihood is that future world increase would be more rapid, not smaller, than in the past. Strangely enough, the authors say nothing about the prospects for drastic declines in the birth rates of these areas, though this alone would permit both low mortality and moderate increases in numbers. The support advanced for expecting world population to stabilize in the foreseeable future, much less at any fairly specific figure, is equally flimsy. The cited number of 4 billions is based on nothing more substantial than an adjustment of a logistic curve constructed about 1930, which had the much lower "maximum" of about 2.6 billions. The figure of 4 billions is obviously intended to serve as no more than a crude benchmark, but so could much larger values. India alone, growing at the moderate annual rate of 1 per cent for the next 150 years, could account for the excess of the cited "maximum" over the world's present population.

The authors' failure to define terms may have raised issues which are more semantic than substantive. Many would share their views on "overpopulation" if this means that the underdeveloped areas can not support large numbers or that even substantial growth is an inevitable forerunner of "catastrophe." Surely, however, these are the extreme contingencies. To the reviewer, nothing in this book contradicts what he takes to be the basic propositions of the overpopulation thesis in its modern setting. Size and growth of population in most of Asia and much of Latin America give every appearance of being serious obstacles, rather than aids, to the attainment of sustained rises in levels of living. Demographic tensions in these regions may or may not prevent such rises, but they are certain to delay or dampen them. Population growth in the less densely settled parts of Latin America and in Africa may provide positive supports to development under some circumstances (i.e., through economies of scale and specialization), but even here the drain of added numbers on natural resources would be a powerful offsetting factor. Throughout the underdeveloped world, the risks of adverse growth have been considerably enhanced by the recent emergence of techniques for reducing mortality both sharply and rapidly. Since low mortality is a universal social goal and emigration a negligible prospect, the burden of reducing population pressure falls on fertility. Yet for two-fifths of the world's peoples, even unprecedented declines in fertility would fail to remove the presence of powerful demographic pressures on economic welfare.

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The Challenge of Man's Future: Harrison Brown, The Viking Press, Inc., New York, 1954, 290 pp., $3.75.

"When we look into the dimness of the distant future we see the possibility of the emergence of any of three possible patterns of life. The first and by far the most likely pattern is a reversion to agrarian existence." The alternatives are "the completely controlled, collectivized industrial society" or a "free industrial society in which human beings can live in close harmony with their environment." So concludes Harrison Brown, Professor of Geochemistry at the California Institute of Technology, after an incisive, sober, and well-balanced examination of the probable alternative developments of population growth and resource consumption. His arguments,

which are developed quite systematically and logically, are not unlike those of others who have recently contributed to the neo-Malthusian tradition. In brief, it is the familiar thesis that the ratio of population increase to resource consumption is becoming increasingly unbalanced. Although the earth can support *potentially* several times its present population, radical readjustments in habits and organization would be required. At present, even assuming no further population increase, total caloric production would have to be increased by at least 20 per cent to raise average world consumption up to minimum standards. Brown estimates that only a 12 per cent increase of food production appears to be obtainable with existing techniques and there is no question of world population not increasing.

The ultimate future of machine civilization is confronted with several unpleasant alternatives. Industrial centers can be destroyed by modern warfare, and a return to an agrarian civilization will be the consequence. If it escapes this, there is the inevitable prospect of the industrialization of underdeveloped areas and the ever-increasing depletion of mineral resources and energy supplies. To avoid this, the problem becomes one of economies that can be accomplished only by rigid and comprehensive state control. The locus of power will shift to those who "organize," "coordinate," and "integrate."

Although Professor Brown paints a somewhat pessimistic picture of man's future, he maintains an abiding faith in the power of man to arrive rationally at some solution that would at least have the effect of slowing up both the rate of resource depletion and the rate of genetic deterioration that differential fertility and social selection have precipitated. Unlike some other writers in this field, however, he does not minimize the difficulties, particularly those in the area of international relations. It is thus with little power of conviction that he proposes a program of conception control which would incorporate, as its most important feature, state regulation of the number of abortions, with the aim of maintaining population stability through the adjustment of the birth rate to the level of mortality. It may be that there simply are no feasible solutions—a possibility which he readily admits but is reluctant to conclude.

A really remarkable feature of this work is the apparent intellectual versatility of the author who, though by profession a geochemist, seems to be quite at home in the fields of demography, nuclear physics, nutrition, etc. His chapter on vital statistics, for example, is quite competently handled. On the whole, Brown has very effectively blended together his knowledge and research of widely diverse fields into a very readable and provocative book.

There is one basic kind of criticism, however, that can be leveled at this and other recent contributions of a similar nature without at all attempting to minimize the seriousness of the problem. The classical criticism of Malthus is that he failed to foresee man's technological ingenuity. Could it be that writers in the modern tradition are forgetting the lesson that the future may contain as yet completely unforeseen developments? It has not been many years ago, for example, that the potentialities of atomic energy were unrealized. Of course no one knows and it would be sheer folly to proceed blithely on the assumption that man has an infinite amount of resourcefulness at his command. But it would be refreshing to see these writings occasionally tempered with a little more modesty. It should be stated, however, that Brown has not erred as much in this direction as others.

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ABSTRACTS

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GENETICS

Quantitative studies on the urinary cystine in patients with cystine stone formation and in their relatives, H. Harris and F. L. Warren. *Annals of Eugenics* **18** (1953), pp. 125–171.

Kidney stones composed of the amino-acid, cystine, probably are due to two different recessive genes, each capable of producing disease when present in the homozygous (double) state. (Such cases constitute about 2 per cent of patients with kidney stones.) These patients excrete large amounts of cystine in their urine, together with two other amino-acids, and the condition is therefore known as cystinuria.

The authors studied 21 families in which cystine kidney stones had occurred. They made precise measurements of cystine excretion and found that the families could be classified conveniently into two groups. In all families inheritance of the disease appeared to be recessive, but in one group of families, carriers of the gene could be detected by slightly increased amounts of cystine in the urine, while in the other group, carriers were indistinguishable from normals.

It is estimated that, in the United Kingdom, between 0.2 per cent and 1 per cent of all people are carriers of a gene for cystinuria.

The Caribe Cuna moon-child and its heredity, C. E. Keeler. *Jour. of Heredity* **44** (1953), pp. 163–171.

Among the Cuna Indians of Lower Panama, albinos are more frequent than in any other population in the world. In addition to white, blistering skin, the abnormal individuals have white or blond hair, clear blue, sun-sensitive eyes and unusually long, fine body hair. Their urine, also, is abnormal. They are prone to minor infections and are below average in physical endurance, but by their persistence some attain positions of leadership. The trait is inherited in a simple recessive manner and is readily distinguishable from other types of blondness which are found in the population. However, among the Indians the defect is generally attributed to maternal impressions or diet.

The albino condition occurs throughout the wide distribution of the Caribe-Cuna people and may have been derived from the Aztecs or Navajos, known to have some albinism. It maintains a relatively high frequency in the Cuna despite physical inferiority of the albinos and despite their apparently subnormal sexual development and activity. Furthermore, tribal taboos prevent most of them from marrying or having children. Evidently the gene is perpetuated by the heterozygous carriers, who are normal except for a perceptible reduction in skin pigment. This slight blondness is seen in the parents and children of the albinos.

Is Rh facing a crossroad? A critique of the compensation effect, C. C. Li. *Amer. Naturalist* **87** (1953), pp. 257–261.

Hemolytic disease of the newborn, or *erythroblastosis fetalis,* is the cause of death of many babies of Rh-negative mothers. Such babies are all heterozygous, having an Rh-negative gene from their mother and an Rh-positive gene from their father. Therefore, the death of these babies destroys the two kinds of gene in equal numbers. The situation resembles the end of a checker game; whichever gene is less frequent is reduced more severely by each elimination and should eventually disappear. On this basis we should expect the Rh-negative gene to have been eliminated

long ago, and some explanation must be found for the continued presence of 15 per cent of Rh-negative people in the American white population. The explanation has been offered that Rh-negative mothers who lose babies from erythroblastosis compensate, if they can, by having additional pregnancies, and among such adtional babies only those survive who have two Rh-negative genes. Bentley Glass has obtained population data which demonstrate this compensation effect; in fact, among Baltimore whites, Rh-negative mothers leave more living children than do Rh-positive mothers.

It has been inferred by some that this compensation should just balance the effects of the disease, maintaining the gene at a fairly constant level. However, the author proves mathematically that a stable equilibrium of this sort is not possible, and that the Rh-negative gene must be either increasing or decreasing. Now the gene is apparently on the increase, but this is related to modern fertility trends. When families are large, the losses from erythroblastosis cannot be made up, so that effective compensation has been possible only in recent generations. Previously the gene should have been decreasing in frequency, and a different theory is needed to explain why it was not more nearly eliminated before family planning introduced effective compensation.

Under present conditions it appears that the tendency of parents to compensate for lost children is increasing the frequency of erythroblastosis. This is only temporary, however; when the Rh-negative gene becomes very frequent, most fathers will themselves be Rh-negative. Increasing frequency of the gene will then lower the incidence of the disease by reducing the number of incompatible marriages. At that time, if the disease should still be difficult to treat medically, compensation for erythroblastotic babies could be regarded as a eugenic measure.

The incidence of harelip and cleft palate related to birth rank and maternal age, B. MacMahon and T. McKeown. *Amer. Jour. Human Genetics* **5** (1953), pp. 176-183.

Congenital harelip (cleft upper lip) appears to be causally related to advanced maternal age. Among 218,693 babies born to mothers of Birmingham, England, in the years 1940–1950, there were 285 cases of harelip and/or cleft palate. For most of these babies, data were available on birth rank and maternal age. Cleft palate was found to have a statistical distribution distinct from that of harelip: when it occurred alone, cleft palate was unrelated to maternal age, but harelip, with or without cleft palate, was nearly four times as frequent when mothers were 38 and over as when mothers were much younger. Again, females predominated among infants with cleft palate and no harelip, while males predominated among those with harelip. Neither condition showed a significant relation to birth rank after correction for maternal age.

More than 20 different significant malformations were associated with harelip and/or cleft palate. Malformations occurred in 14.9 per cent of babies with cleft palate alone; among babies with harelip, the figure ranged from 9.1 per cent in those with plain harelip to 21.0 per cent in those with harelip *and* cleft palate. Thus the defects related to maternal age present the more variable picture.

Genetic determinants of hypoxia-induced congenital anomalies, T. H. Ingalls *et al. Jour. of Heredity* **44** (1953), pp. 185–194.

Mouse embryos of different strains have different susceptibilities to artificially induced malformations. The authors observed the effects of severe oxygen-deprivation in five different inbred strains by subjecting pregnant mice to a simulated altitude of 27,000 feet at specified points in embryonic development. This increased fetal mortality in only one of the five strains, but the surviving fetuses showed a high frequency of anomalies such as umbilical hernia and eye defects.

The relative frequencies of several anomalies varied from one strain to another, but strains with a natural tendency to develop a certain anomaly did not necessarily show the highest frequency of this anomaly when

subjected to hypoxia. In the strain with the highest natural frequency of rib and vertebral anomalies (18 per cent), hypoxia produced no increase at all, while in the other four strains the stress increased the anomalies to 30, 63, 66 and 75 per cent. Harelip with cleft palate was apparently not inducible by the treatment schedules employed, even in a strain with a naturally high frequency of the condition. In one strain with a characteristic defect of the breast bone, hypoxia suppressed development of this defect.

This experiment demonstrates what is commonly neglected in the experimental study of congenital defects: genetic constitution and maternal environment interact throughout prenatal development, so that environmental factors producing an anomaly in one individual may be harmless to one with a different heredity.

Muscular dystrophy in Northern Ireland, A. C. Stevenson. *Annals of Eugenics* **18** (1953), pp. 50–93.

Muscular dystrophy includes a variety of diseases with different symptoms. Progress in understanding the heredity of the several diseases has been impeded by the difficulty of separating the clinical types.

The author presents data on 51 families, which were thought to include nearly all cases of muscular dystrophy in Northern Ireland. For this relatively homogeneous population, he succeeded in classifying all families but one into two groups. The first group of 27 families was affected by the typical *Duchenne* type of muscular dystrophy. This begins in the first two years of life and is fatal before the age of 20. It was found to occur only in boys and was clearly a sex-linked recessive. In another 23 families onset was later, sometimes as late as middle life. The condition progressed more slowly, and some of these persons have lived a normal life span. In these cases the trait was inherited as a simple recessive. The one remaining family appeared to represent a dominant form of the disease, although in some other countries muscular dystrophies not of the Duchenne type are as often dominant as recessive.

The Duchenne type of dystrophy prevents reproduction of affected individuals but is nevertheless the more common condition. The author estimates that, in Northern Ireland, somewhat less than one baby in every 10,000 contains a new mutation capable of producing the disease.

Selection for large and small size in mice, D. S. Falconer. *Jour. of Genetics* **51** (1953), pp. 470–501.

Under artificial selection, mice can be altered readily toward either large or small size. Two lines of mice taken from one original mixed stock were selected for large and for small size, respectively. These strains diverged in weight, and after eleven generations the large mice were, on the average, 1.75 times as heavy as the small ones, and 1.17 times as heavy as the original stock. The changes in size occurred intermittently during the eleven generations but showed no tendency to slow down as the experiment continued. No specific hereditary factors for size were known in the original stock, but calculations indicated that the two strains obtained after eleven generations differed with respect to at least 19 hereditary factors affecting size. Selection for largeness was found to be only 20 per cent efficient; that is, 80 per cent of the ground gained in each generation was lost in the next. Selection was 50 per cent efficient for smallness, although this appeared to involve fewer dominant genes.

This experiment emphasizes two antithetical principles which are applicable to either positive or negative eugenics: (1) Without knowledge of the exact hereditary basis of a variable physical trait, artificial selection can in general be expected to alter the trait in any desired direction. (2) Even for a simple metric character under controlled conditions, such blind selection is unfair to a large proportion of individuals because so much of the variation is not heritable, or is due to complex heredity that responds slowly to selection. It must also be emphasized that in this experiment selection was for size alone, and the final strains may have been subnormal in other important respects.

WORLD POPULATION CONFERENCE

Rome, August 30 — September 10, 1954
Session B–10 — Organizer: FREDERICK OSBORN

Relation of Population Changes to Distribution of Genetic Factors

Section I: PREVALENCE OF GENETICALLY BASED PHYSICAL AND MENTAL DEFICIENCIES AND THE FREQUENCY OF RELATED GENES.

Chairman:
Dr. Jan A. Böök
Assistant Director, State Institute for Human Genetics, Uppsala, Sweden

1. Information available on various population groups and methods of investigation.
Dr. Tage Kemp
University Institute of Human Genetics, Copenhagen, Denmark
Dr. Alberto Leon, Director
Instituto de Salubridad y Enfermedades Tropicales
Carpio y Plan de San Luis, Mexico 17, D.F.

2. Effect of age composition, age of mother, order of birth, environmental influences.
Dr. Thomas McKeown, Department of Social Medicine
The Medical School, University of Birmingham
Edgbaston, Birmingham 15, England

3. Detection of carriers of recessive genes.
Mr. Robert C. Cook
Director, Population Reference Bureau
1507 M Street, N.W., Washington 5, D. C.,
Dr. Harold Falls
University Hospital, Department of Ophthalmic Surgery
University of Michigan, Ann Arbor, Michigan, USA

Section II: SHORT AND LONG-TERM INFLUENCES OF VARIOUS FACTORS ON THE FREQUENCY OF GENES WHICH AFFECT THE CHARACTERISTICS OF POPULATION.

Chairman:
Dr. L. S. Penrose
The Galton Laboratory, University College
Gower Street, London W.C.1., England

1. Mutation rates and factors affecting mutation.
Dr. Hans Nachtsheim
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Berlin-Dahlem, Germany

2. Effects of differences in fertility and mortality.
Professor C. H. Waddington
Institute of Animal Genetics
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3. Effects of inbreeding, outbreeding, crossbreeding, marriage customs, migration.
Dr. Ken'ichi Kishimoto
Research Institute of Environmental Medicine
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Dr. L. D. Sanghvi
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(Probably Section II—Title of paper not yet definite)
Dr. Tanemoto Furuhata
Department of Legal Medicine
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Section III: CONCLUSIONS ON THE DISTRIBUTION OF GENES AFFECTING THE CHARACTERISTICS OF THE POPULATION.

Chairman:
Dr. Curt Stern
Department of Zoology
University of California
Berkeley 6, California, USA

1. Probable trends.
Dr. Torsten Sjogren
Karolinska Institutets Psykiatriska Klinik
Stockholm 60, Sweden

2. Current and future research.
Experimental investigation of hereditary differences in learning in mammalian populations.
Dr. J. P. Scott
Dr. John L. Fuller
Roscoe B. Jackson Memorial Laboratory
Hamilton Station, Box 847
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Twin studies.
Dr. Luigi Gedda
Instituto de Genetica Medica e Gemellologia "Gregorio Mendel"
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3. Contribution of demography to population genetics.
Professor Sir Ronald Fisher
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Cambridge, England

News Notes

The Population Association of America held its annual meeting on May 8 and May 9, 1954, at Charlottesville, Virginia. Of special interest to eugenists were the following papers: Economic and Social Factors Affecting Fertility in Mysore State, C. Chandrasekaran, United Nations; Marriage and Divorce in a Midwestern County: An Analysis by Record Linkage, Harold T. Christensen, Purdue University; The Effect of Nuptiality on the Reproduction of Population Under Conditions of Natural Fertility, Jean Bourgeois-Pichat, United Nations; Some Demographic Characteristics of Recently Married Persons: Comparisons of Registration Data and Sample Survey Data, Hugh Carter, National Office of Vital Statistics, Paul C. Glick, Bureau of the Census, Sarah Lewit, National Office of Vital Statistics.

New Cancer Section in *Excerpta Medica*

Excerpta Medica (111 Kalverstraat, Amsterdam-C) is now publishing a new monthly section on cancer to meet the demand for an abstract journal covering the cancer field. It will contain 700-800 pages of abstracts a year. Single volumes of 12 monthly issues cost $10.00.

Appointments Open at Michigan State College

The School of Graduate Studies at Michigan State College is offering appointments to pre- and post-doctoral students which include graduate assistantships, tuition scholarships, pre-doctoral and post-doctoral fellowships. Inquiries should be directed to the Dean, School of Graduate Studies, Michigan State College, East Lansing.

Science News Letter in Interlingua

Scientia International, the monthly Interlingua edition of *Science News Letter,* carries the news of science to the non-English speaking parts of the world. It contains careful selections from the English language weekly edition in Interlingua which is a linguistic system unifying the dialects of the Western world. Under the sponsorship of Science Service Interlingua is making a strong bid to serve as the medium of international communication in science.

Age of Marriage

The reduction in age at marriage has been greater among women than among men in the northwest European countries. In the United States, New Zealand, and Australia the age of men at marriage has fallen more (*Population Studies,* Nov. 1953).

Genetically Controlled Animals in Medical Research

The need for genetically controlled animals for medical and scientific research is being increasingly recognized throughout the world, according to Dr. Clarence C. Little, Director of Roscoe B. Jackson Memorial Laboratory. The production, use, and distribution of such animal material has been the chief strength of the Laboratory's service program.

The year 1954 marks the Laboratory's first quarter-century of service. It will direct its activities in the second twenty-five years to increase our knowledge of "constitutional" diseases.

Inadequacies of Present Marriage Education

Too few college-level courses on marriage education are being offered, and a still smaller proportion of high schools offer such courses. Many courses which pass as marriage education are probably not as fully such as instructors would have us think. Marriage education has moved from zero to the first percentile, but we have only scratched the surface. The above conclusions are offered by Henry A. Bowman, Department of Marriage Education at Stephens College (*Marriage and Family Living,* Nov. 1953).

American Eugenics Society

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Address of His Holiness Pope Pius XII to those attending the *Primum Symposium Geneticae Medicae* (Sept. 7, 1953)
Major Policies of the American Eugenics Society
Possible Effects of Differential Fertility on Genetic Endowment, Frederick Osborn
Eugenic Hypothesis, Frederick Osborn
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To promote research on the interaction of biological and social factors in human development and on conditions influencing the distribution of births.

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To cooperate with the medical profession in reducing the burden of constitutional weaknesses and defects.

To encourage conditions and attitudes tending to reduce the number of unwanted children and especially of those conceived with indifference to the responsibilities of parenthood.

To encourage conditions and attitudes tending to increase the proportion of children born with promise of sound character and good intelligence.